DOCUMENT RESUME

ED 207 825 SE 035 620

TITLE	University Curricula in the Marine Sciences and Related Fields, Academic Years 1979-1980, 1980-1981.
INSTITUTION	National Oceanic and Atmospheric Administration (DOC), Rockville, Md. National Sea Grant Program.
PUB DATE	81
CONTRACT	DOC-NA-79-SAC-00669
NOTE	304p.; Not available in paper copy due to small print.
AVAILABLE FROM	Director, Office of Sea Grant, National Oceanic and Atmospheric Administration, 6010 Executive Blvd., Rockville, MD 20852 (free while supply lasts).
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	College Science; *Course Descriptions; *Degree Requirements; Ecology; Engineering Education; Environmental Education; Fisheries; Higher Education; *Marine Biology; *Oceanography; *Program Descriptions; Science Curriculum; Science Education; *Science Programs; Technical Institutes
IDENTIFIERS	*Marine Education

ABSTRACT

A listing of courses and programs offered by selected universities, colleges, and technical institutions in the United States and Canada is provided to assist students planning careers in the marine sciences and others who need current information on marine-related programs. Institutions included offer programs of at least 25 semester hours in the marine education field. In addition to traditional courses and programs, programs in marine law, fisheries and food science, the maritime field, and naval architecture are also described. The alphabetical listing by institution includes information on: (1) facilities including research labs and vessels; (2) undergraduate and graduate degree programs; (3) marine courses; (4) faculty members; and (5) contact person for further information. (Author/DC)

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University Curricula in the Marine Sciences and Related Fields

Academic Years 1979-1980, 1980-1981

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This publication has been produced by the Marine Technology Society, Washington, D.C. under Department of Commerce Contract # NA-79-SAC-00669. It is supported by the Office of Sea Grant/National Oceanic and Atmospheric Administration/Department of Commerce. Additional copies can be furnished at no charge (based on limited supply) by written request to:

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FOREWORD

Mankind's dependence on the marine world is increasing every day. Whether for food, minerals, pharmaceuticals, transportation or recreation, men and women are looking in ever increasing numbers to the oceans, seas and lakes of the world.

University Curricula in the Marine Sciences and Related Fields is designed to assist students planning careers in the marine sciences, and others who need current information on marine-related courses offered by universities, colleges and technical institutions in this country.

We appreciate the cooperation of the institutions that provided the information included in this edition.

Ned A. Ostenso
Director
National Sea Grant College Program
National Oceanic & Atmospheric
  Administration

INTRODUCTION

General

This edition of University Curricula in the Marine Sciences and Related Fields, the ninth in a series inauguarated by the old Interagency Committee on Oceanography, is designed to answer the question often asked by students and guidance counselors about which colleges and universities offer marine courses.

Its purpose is to provide a guide rather than a definitive description of current offerings in the marine field. Students, couselors and others using the volume should select from it institutions of interest to contact directly for full information concerning admission requirements, scholarship-fellowship availability, the specific courses which are being offered during particular semesters and related matters.

The information in this publication was provided by officials at each college or university. As the material was gathered during the early part of 1979, references in some of the program descriptions to "this year" likely mean the 1978-79 academic year.

The criterion for including an institution in this edition was that it offer a program of at least 25 semester hours in the marine field, broadly defined. Although the number of responding institutions has increased since the last edition, several institutions which would otherwise qualify were not able to prepare their material in time for inclusion. In all, 350 questionnaires were distributed.

Institutions were asked about programs in all areas of marine studies, from two-year technology training courses to Ph.D. offerings. Programs in marine law, fisheries and food science, the maritime field and naval architecture were specifically included, as well as any new interdisciplinary programs that might fall outside traditional organizational structures.

Reports from the institutions are listed alphabetically and are organized as follows:

- A description of the facilities available, including research labs and vessels
- The degree programs in the marine field, usually with the entrance and course requirements specified
- A list of the marine courses offered and the credit given, according to each school's system
- A list of the faculty members involved with the degree programs, alphabetically and in most cases with the highest degree earned
- The name of the contact person for further information.

The geographic index will help identify facilities in a given region.

Scholarship Information

There are a number of excellent guides to scholarship information available. Without exception, they point to the institutions themselves as the principal source of information, but nonetheless, provide useful descriptions of the different types of aid programs available.

One of the best, is published annually by the American Legion. "Need a Lift?" is published by them each fall and one copy is available free by writing to the American Legion National Headquarters, P.O. Box 1055, Indianapolis, Indiana 46206. Additional copies are available for 50¢ each. While this brochure is naturally heavy in emphasis on aid to children of veterans, it is a comprehensive listing of government, business and organization-provided aid. The 132-page booklet (1978 edition) describes the $4 billion that is available to qualified students. Included in the American Legion publication is a list of books carried in most libraries which provide guides to colleges and scholarship assistance. The booklet also provides a state-by-state list of educational benefits and eligibility requirements for each.

Students and counselors would also be well advised to contact a U.S. Representative or Senator from their home state for copies of available Federal Government documents describing current aid programs. Such programs often undergo change and it would be important to obtain the most recent information available. The U.S. Office of Education currently makes available a one-page fact sheet outlining its aid programs.

High school guidance offices will have information available about sources of financial aid and can provide leads to publications available in the communities which provide further information.

Career Guidance

Students looking into the marine field as a possible future career would do well to talk to as many people familiar with the field as possible. Oceanography has attracted considerable worldwide attention and has also been the object of some exaggerated estimates of future growth as a field of endeavor.

A realistic guide to the field from the career standpoint is the booklet, "The Oceans and You," published by the Marine Technology Society ($3.00 prepaid), 1730 M Street, N.W., Suite 412, Washington, D.C. 20036. Included are two introductory discussions of the field, job descriptions from sample employers among private industry, government agencies and universities; a capsule list of institutions offering marine programs; a comprehensive reading list; a description of marine technician training programs; a list of sources of additional information about the field, and some suggestions about personal actions for an interested individual.

Other career guidance publications which have been produced in recent years and might still be available include: So You Want to Be a Marine Scientist, Miami Seaquarium, Rickenbacker Causeway, Miami, Florida; Geophysics, the Earth in Space, American Geophysical Union, 1707 L Street, N.W., Washington, D.C. 20036; Your Career in Oceanology, by Norman H. Gaber, Richards Rosen Press, New York, New York 1967, $4.00; and Training and Careers in Marine Science, International Oceanographic Foundation, Virginia Key, Miami, Florida.

Good sources of general information are the Federal Government agencies with marine programs. Among them are:

Department of Commerce, National Oceanic and Atmospheric Administration and Maritime Administration

Department of the Interior, Geological Survey and Bureau of Sport Fish and Wildlife

Department of the Navy, Office of Naval Research, Naval Oceanographic Office and Oceanographer of the Navy

Department of Transportation, U.S. Coast Guard.

Additional information may be obtained from such diverse sources as the Department of State, Smithsonian Institution and Environmental Protection Agency.

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ADELPHI UNIVERSITY

Garden City, Long Island, New York 11530

Marine related activities at Adelphi University are centered in the Departments of Biology, Earth Science and Physics. Currently, the instructional and research energies of eight faculty are marine oriented. The Departments of Biology and Earth Science offer the Marine Science degree with a marine orientation. The University maintains the R/V Shuttle, and a Boston Whaler to implement programs of research and education. Opportunities for oceanographic cruise experience and research are available and encouraged.

Equipment available for estuarine and ocean teaching and research include induction salinometers, submarine photometer, otter trawl, seine nets, oxygen analyzers, specific-ion probes, pH meters, spectrophotometers, microscopes, photographic equipment, scuba gear, climate control chambers, centrifuges, a seismic hammer with six chambers, and water and bacteriological samplers.

The following degrees are offered:

1. B.A. Interdisciplinary Major in Marine and Environmental Science, sponsored by Biology and Earth Science Departments and Institute of Marine Science. Degrees granted (12).

a) Biology	20 credits
b) Earth Science	20 credits
c) Chemistry	12 credits
d) Physics	8 credits
e) Mathematics	8 credits

2. M.S. in Biology with specialization in Marine Biology. Degrees granted (62).

Thirty-three credits including 6 for thesis research.
Comprehensive examination, oral or written.

3. M.S. in Earth Science with specialization in Marine Science and Environmental Science. Degrees granted (15).

Successful completion of 33 graduate credits as follows:

a) Earth Science	21-24 credits
b) Mathematics	3-6 credits
c) Electives	3-6 credits

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Bio 234	Ecology	4
Bio 250	Invertebrate Zoology	4
Bio 253	Marine Biology	4
Bio 310	Biological Communities	4
Bio 490	Independent Study	4
Bio 512	Biogeography	4
Bio 575	Marine Biology Field Trip	2
EAS 104	Environmental Geology	3
EAS 224	Marine Science	4
EAS 465	Scientific Diving	4

GRADUATE COURSES

Bio 614	Ecological Systems	4
Bio 632	Biological Oceanography	3
Bio 636	Ichthyology	4
Bio 637	Marine Botany	4
Bio 638	Marine Ecology	4
Bio 639	Marine Microbiology	4
Bio 701	Marine Seminar	2
Bio 790-91	Special Research Problem	2-3
Bio 798-99	Thesis Research	6
EAS 611	Geostatistics	3
EAS 635	Environmental Monitoring	3
EAS 636	Environmental Resources	3
EAS 637	Environmental Pollution & Conservation	3
EAS 654	Oceanography	3
EAS 674	Hydrogeology	3
EAS 727	Geochemistry	3
EAS 728	Marine Chemistry	3
EAS 761	Marine Geology	3
EAS 765	Coastal Processes	3
EAS 798	Guided Research	3
EAS 799	Thesis Research	3
EAS 801	Environmental Management I	3
EAS 802	Environmental Management II	3
PHY 655	Physics of Marine Environment	3

The instructional staff for the marine oriented program consists of the following:

Brenowitz, A. Harry, Ed.D., Professor
Cassin, Joseph M., Ph.D., Associate Professor
Churchill, A. Coolidge, Ph.D., Associate Professor
Dooley, James K., Ph.D., Assistant Professor

EARTH SCIENCE

Cok, Anthony, Ph.D., Assistant Professor
Sirkin, Leslie, Ph.D., Professor
Starmer, John, Ph.D., Assistant Professor

PHYSICS

Garrell, Martin, Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Marine Program Coordinator
Department of Biology
Adelphi University
Garden City, Long Island, N.Y. 11530

ALABAMA STATE UNIVERSITY

Montgomery, Alabama 36101

Alabama State University, through affiliation with the Marine Environmental Sciences Consortium, offers a major in Biology with emphasis in Marine Biology. Students pursuing this program are required to complete the general college requirements, and a minimum of 25 credit hours of Marine Science courses.

The courses in Marine Biology are offered only at the Dauphin Island Sea Laboratory located on Dauphin Island, Alabama. The facilities at the Sea Lab include laboratories with research equipment, and faculty offices.

The requirements for the B.S. degree with emphasis in Marine Biology are:

General Studies requirements	64 credits
Electives	9-13 credits

BIOLOGY REQUIREMENTS (Montgomery campus)

Bio 240	Invertebrate Zoology	5
Bio 241	General Botany	5
Bio 336	Genetics	5
Bio 337	Cell Biology	5
Bio 442	Biological Techniques	5
Bio 450-451	Seminar	2
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MARINE BIOLOGY COURSES (Dauphin Island)

Bio 433	Marine Biology	6
Bio 438	Marine Ecology	6
Bio 439	Marine Vertebrate Zoology	6
Bio 440	Coastal Ornithology	6
Bio 442	Seminar	1
		25

CHEMISTRY	
Inorganic	15
Organic	15
TRIGONOMETRY	5
PHYSICS	12
FOREIGN LANGUAGE	19
	60
Total Credit Required	186-190

The instructional staff for the biology courses listed above consists of the following:

BIOLOGY (Montgomery campus)

Igwegbe, E. Chuma, Ph.D., Assistant Professor
Mayfield, John E., Ph.D., Assistant Professor
Oliviere, James, Ph.D., Professor

MARINE BIOLOGY (Dauphin Island Sea Lab)

The Marine Environmental Sciences Consortium supplies instructional staff for the Marine Biology courses.

To obtain further information, address inquiries to:

Dr. James Oliviere, Chairman
Division of Biological Sciences
Alabama State University
Montgomery, Alabama 36101

THE AMERICAN UNIVERSITY
Washington, D.C. 20016

The American University offers to students one of the most unique and diverse marine science academic programs in the nation. Nearly one hundred courses are offered in environmental and marine sciences, with about half on campus and half at field stations or marine laboratories or aboard ship.

The American University (A.U.) has affiliations or memberships with selected regional marine institutions including: (1) the Marine Science Consortium, (2) Sea Education Association, (3) the U.S. National Park Service (Lightship Chesapeake), (4) U.S. National Aquarium. Affiliations are pending with (1) the Gulf Coast Research Laboratory, Ocean Springs, Mississippi, and (2) the Jean-Michel Cousteau Institute (Project Ocean Search Expeditions). Participation in these numerous and diverse programs provides students with a multi-habitat (world-wide) marine academic experience. Students register for all course work and research (on and off campus) through The American University.

The variety of field research facilities enables long-term studies of diverse aquatic environments including the ocean, lakes, estuaries, rivers, lagoons, wetlands, and forests. Partly and wholly-funded graduate and undergraduate internships allow local work-study projects in aquaculture, limnology, and environmental education. Research and teaching fellowships are available at the graduate level. Coursework and research facilities are also available through numerous government agencies in the area and through the Washington Area Consortium of Universities (Georgetown University, George Washington University, Howard University, Catholic University and others). In each case, the academic registration is made through A.U.

A.U. faculty funded research interests include remote sensing (wetland mapping, water quality and land use in national parks); ocean dumping of municipal and industrial wastes; environmental assessment and monitoring in lakes, reservoirs, rivers (Columbia, Mississippi, Potomac and the Amazon), estuaries (Chesapeake Bay, Delaware Bay and Chincoteague Bay), and oceans (North Atlantic, Gulf of Mexico, Caribbean, and Mediterranean); distribution and abundance of organisms; invertebrate zoology; fisheries; ecological studies in salt marshes; nationally recognized Project IBIS (Intensive Biometric Intertidal Survey); marine optics/spectral distributions/productivity/respiration and many others.

SEA Semester: Students spend six weeks at Woods Hole and six weeks aboard the Westward (a 110-foot sailing ship) in the Atlantic or Caribbean, for 16 undergraduate credit hours.

The Marine Science Consortium at Wallops Island, Virginia: About 25 courses are offered in the field during summers. Opportunities for independent research. Research cruises and Project IBIS (salt marsh research) are especially well known.

Graduate and undergraduate degrees in Oceanography, Marine Biology and other similar fields may be arranged as interdisciplinary programs, or as degree programs in the Department of Biology. Marine and environmental specializations are also available in chemistry, physics and other departments. The Biology requirements are given as representatives of many departments; some interdepartmental degree programs also are listed.

1. B.A. in Biology

a) University Liberal Arts and English Requirements	24 credits
b) Core courses in Biology	37 credits
c) Elective courses in Biology	3 credits
d) Related requirements	8 credits
e) Electives, to complete a minimum of 120 credits	

2. B.S. in Biology

a) Free elective courses in Biology	12 credits
b) University Liberal Arts and English requirements	24 credits
c) Core courses in Biology	26 credits
d) Related requirements (chemistry, physics, math and statistics)	34 credits
e) Electives, to complete a minimum of 120 credits	

3. Two new degrees: B.S. in Marine Biology and B.S. in Marine Science have been submitted for University approval.

4. M.S. in Biology

Thesis degree with specialization in Marine Biology, Marine Science, or Oceanography.

a) Minimum of 32 hours of approved graduate work including six hours Master's Thesis Research and two hours of Graduate Seminar
b) A written comprehensive examination
c) Successful completion, defense and acceptance of a Master's Thesis

5. B.A. in Environmental Studies

May only be taken as a second major, combined with a traditional B.A. or B.S. degree. The student's final degree plan must be approved by a faculty member of the student's department and the Environmental Studies Committee when the double major is declared.

a) A total of 36 credit hours is required for the double major
b) Required courses - 18 credits
c) Of the 18 remaining credit hours, 12 hours must be outside the student's major department and his major degree requirements.
d) Of these 18 remaining credit hours, nine credit hours must be .300 level of above

6. M.S.T.M. In Environmental Systems Management

Thesis-option degree offered by the College of Public Affairs, Center for Technology and Administration. Requires the completion of all foundation requirements or their equivalent (approximately nine credit hours), and completion of 36 graduate semester hours in core requirements, field requirements, and thesis requirements or research and/or seminar. Students must successfully complete one comprehensive examination in the main field of concentration.

7. Graduate Certificate in Environmental Systems Management

The Environmental Systems Management Program offers graduate certificate programs in general Environmental Systems Management, Ocean Affairs Management, and Toxic and Hazardous Materials Management: 18 credit hours.

8. Ph.D. in Environmental Chemistry

A minimum of 72 semester hours of graduate work is required.

a) At least 60 graduate semester hours of chemistry including seven specified courses.
b) Two semester hours of a seminar in chemistry
c) Twelve to 24 semester hours of Doctoral Dissertation Research
d) Eighteen of the graduate semester hours must be chosen from the environmental systems management courses offered by the Center for Technology and Administration

9. Ph.D. in Science Education

a) A minimum of 72 semester hours of graduate credit beyond a bachelor's degree, with at least 12 of these hours being devoted to the dissertation which includes an oral defense. Specific courses may be necessary for certain study areas.
b) Tools of research
c) Qualifying examination must be taken before completion of 24 hours of course work
d) Three written comprehensive examinations and one oral comprehensive examination are required

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

09.203	Introduction to Oceanography
09.204	Marine Biology
09.225	Wildlife Conservation and Management
90.110	Introduction to Oceanography
90.181	Introduction to Limnology
90.200	Perspectives on Environmental Crises
90.205	Introduction to Marine Science
90.206	Man and the Sea
90.207	Introduction to Nautical Science
90.208	Marine Science Laboratory
90.209	Nautical Science Laboratory
90.211	Field Methods in Oceanography
90.212	Marine Navigation
90.221	Marine Invertebrates
90.241	Marine Biology
90.250	Management of Wetland Wildlife
90.260	Marine Ecology
90.280	Field Biology
90.281	Field Methods in Limnology
90.331	Chemical Oceanography
90.342	Marine Botany
90.343	Marine Ichthyology
90.344	Anatomy of Marine Chordates
90.345	Ornithology
90.362	Marine Geology
90.364	Physical Oceanography
90.398	Development of Marine Organisms
90.420	Marine Micropaleontology
90.431	Ecology of Marine Plankton
90.458	Exploration Methods in Marine Geology
90.459	Coastal Geomorphology

GRADUATE COURSES

90.520	Marine Microbiology
90.530	Coastal Sedimentation
90.540	Environmental Science Education
90.570	Marine Pollution Research Cruise
90.571	Tropical Marine Ecology (British Virgin Islands)
09.502	Cooperative Work-Study: Lightship Chesapeake

09.520	Limnology
09.523	General Ecology
09.524	Advanced Ecology
09.550	Scientific Publication
09.555/6	Water Pollution Biology & Laboratory
09.572	Special Topics in Ecology
09.603	Advanced Oceanography
09.623/4	Marine Ecology and Laboratory
90.510	Tropical Marine Ecology
55.580	Environmental Analysis Through Environmental Impact Statements
55.581	Engineering Principles and Marine Management
55.582	Environmental Law and Administration
55.583	Energy, Technology and the Human Environment
55.584	Water, Technology, and the Human Environment
55.586	Coastal and Estuarine Environments
55.587	Law of the Sea
55.588	Dial Access Series in Environmental Systems Management - Air Pollution Problems - Practical Scientific and Technical Writing
55.680	Introduction to Toxic Materials
55.681	Pesticide Degradation in the Environment
55.682	Federal Regulations for Toxic Materials
55.683	Pollution Abatement Potentials
55.685	Workshop In Environmental Systems Management
55.686	Conservation and Environmental Management: Resource Recovery
55.687	Conservation and Environmental Management: Toxic Substances
55.688	Conservation and Environmental Management: Predator Management
55.780	Seminar in Environmental Systems Management

Faculty in Marine and Environmental studies at the American University consist of the following:

BIOLOGY

Anderson, Richard R., Ph.D., Professor (plant physiology, plant taxonomy, remote sensing)
Banta, William C., Ph.D., Professor (morphological development of bryozoa, marine biology and marine ecology)
Champ, Michael A., Ph.D., Associate Professor (aquatic and marine science, limnology, water resources, oceanography)
Chinnis, Robert J., Ed.D., Associate Professor (science education)
Darden, Dorothy L., M.S.T.M. (environmental resources management)
Sager, Martha C., Ph.D., Professor (environmental systems management, limnology), Chairman, Department of Biology

CHEMISTRY

Aldridge, Mary H., Ph.D., Professor (organic chemistry)
Carson, Frederick W., Ph.D., Associate Professor (biochemistry)
Foley, Robert T., Ph.D., Professor (electrochemistry, physical chemistry)
Norton, Matthew F., Ph.D., Professor (geology), Chairman, Department of Chemistry
Rosher, Nina, Ph.D., Associate Professor (physical chemistry)
Waters, Paul F., Ph.D., Assistant Professor

ECONOMICS

Wisman, John D., Ph.D., Assistant Professor (economic thought)

PHYSICS

Harrison, Mark, Ph.D., Professor (fluid dynamics)
Segnan, Romeo A., Ph.D., Professor (Mossbauer spectroscopy)

CENTER FOR TECHNOLOGY AND ADMINISTRATION

Boynton, Robert, Ph.D., Professor (public administration), Director, Center for Technology and Administration
Malone, David W., Ph.D., Associate Professor (systems design and public affairs)
Richardson, John, Ph.D., Professor (global modelling)

SCHOOL OF GOVERNMENT AND PUBLIC ADMINISTRATION

Leiber, Harvey, Ph.D., Associate Professor (environmental management, federalism, public administration)
McCurdy, Howard E., Ph.D., Associate Professor (public administration, organizational theory, comparative administration, the American Presidency, politics in literature and film)

To obtain further information, address inquiries to:

Dr. Michael A. Champ, Ph.D.
Director, Environmental and Marine Science
Department of Biology
The American University
Washington, D.C. 20016
(202) 686-2177

ANNE ARUNDEL COMMUNITY COLLEGE
Arnold, Maryland 21012

There are a variety of Marine Studies opportunities at Anne Arundel Community College. The most prominent one is the Marine Technologies program which includes a Mechanical or Electrical option. Marine-oriented courses are also found in the divisions of physical education, science and continuing education. The Marine Technologies program provides job skill preparation for engineering technology and environmental careers with a marine emphasis. A graduate of the program could be considered an engineering or scientific technician with special marine related skills, knowledge and interests.

Most students enrolled in the Marine Technologies career program plan to seek employment after graduation. Some students plan to transfer into Bachelor Degree programs at other colleges and universities.

A Cooperative Education program has been established where the student works 15-20 hours per week in a position closely related to his field of study. The number of credits taken per semester is reduced, lengthening the program of study to five or six semesters.

Laboratories are an important part of any technical program. The Marine Technologies program has 2,200 square feet of lab space. The labs are equipped with oceanographic and ocean engineering equipment, instrumentation for measuring temperatures, pressures, fluid flow, vibration and other variables, and equipment for analyzing environmental data samples. There is a high pressure test facility for testing ocean equipment at a simulated ocean depth of 22,000 feet. Equipment can also be tested in an open surface nine-foot deep, six-foot diameter water filled tank.

Outdoors field work is an important part of the program. Instruction takes place aboard a 26-foot diesel-powered research vessel equipped with compass, recording fathometer, VHF-FM radiotelephone, radar, Loran C, two booms and hand winches, and a deckhouse lab area. A 16-foot outboard skiff with boom and winch is also used.

The Anne Arundel Community College Marine Studies Field Station is a 400 square foot building with a dock located on a tributary of the Chesapeake Bay.

Degrees offered: Associate of Arts, Marine Technologies. Degrees offered (6).

The following program of study is for the Marine Technologies program.

MRT 111	General Oceanography	3
MRT 114	Field Techniques in Marine Sampling	4
MRT 115	Small Boat Seamanship	4
MRT 211	Mechanical Measurements and Instruments	4
MRT 212	Ocean Engineering Technology	2-3
MRT 214	Marine Science & Technology Seminar	3
MRT 220	Marine Technology Project	1
EET 118	Electrical Fabrication Skills	3
MATH 121	Algebra and Trigonometry	4
MATH 122	Mathematics with Calculus	4
PHY 111	Fundamentals of Physics I	4
GT 111	Communications in Technology	2
GT 112	Technological Problem Solving-Computer	2
ENG 111/112	Composition and Introduction to Literature I and II	6
	Electives	3-4
PE	Physical Activities or Scuba	

ELECTRONICS/MARINE TECHNOLOGY OPTION

EET 115/116	Circuits I, II	8
EET 209	Communications Electronics	4
	EET Elective	4

MECHANICAL/MARINE TECHNOLOGY OPTION

MET 111	Engineering Graphics I	3
MET 121	Manufacturing Processes	3
MET 122	Engineering Materials	3
MET 243	Statics and Strength of Materials	5

Full time instructional staff for the engineering technology courses consists of the following individuals:

ELECTRICAL ENGINEERING TECHNOLOGY

Kilian, Christopher T., M.S., Assistant Professor
Liimatta, Peter E., M.Ed., Associate Professor
Miller, Charles G., M.S.E.E., Associate Professor
Smith, Robert J., M.S.E.E., Associate Professor
Theiss, Jr., Gordon F., M.E.E., Associate Professor

MECHANICAL ENGINEERING TECHNOLOGY

Somers, George W., M.S.M.E., Associate Professor

MARINE TECHNOLOGIES

Gucinski, Hermann, M.S.T.A., Associate Professor
Stibolt, Kenneth A., M.S.M.E., Professor

To obtain further information, address inquiries to:

Kenneth A. Stibolt
Professor, Director
Marine Technologies
Anne Arundel Community College
101 College Parkway
Arnold, Maryland 21012
(301) 647-7100, ext. 380

BELLINGHAM VOCATIONAL-TECHNICAL INSTITUTE*
Bellingham, Washington 98225

A 41-foot boat, BelleTech, is rigged for trawling and purse seine. A net loft is also used at Bellingham harbor for net work.

COMMERCIAL FISHING COURSE

This is a course designed to prepare persons with little or no previous experience to enter employment as crew members on commercial fishing vessels. The graduate will be able to serve on board a variety of fishing ships, including those used for purse seining, otter trawling, gillnetting, reef-neeting, trolling and halibut fishing.

The Commercial Fishing course is nine months long. Classes operate five days per week for a total of 1,080 hours. The class schedule is as follows: Morning 8:30 a.m. to 11:30 a.m.; lunch 11:30 a.m. to 12:30 p.m.; afternoon 12:30 p.m. to 3:30 p.m. Students may also enroll on a half-time basis, taking either the morning or afternoon class.

Course Outline

1. Introduction to Commercial Fishing
   a) Overview of fishing industry
   b) Common methods of commercial fishing

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* Special entry of interest.

2. Orientation to the Vessel

  a) Teamwork
  b) Common deck equipment
  c) Navigation aids
  d) Marine terminology
  e) Work stations
  f) Crew members and their responsibilities

3. Seamanship

  a) Skiff handling and operation
  b) Docking, anchoring, and line handling
  c) Stowage of equipment
  d) Clothing and protective gear
  e) Health and personal hygiene
  f) Conservation of water, electrical power, and other resources

4. Navigation and "Rules of the Road"

  a) Use of navigation aids
  b) Plotting a course
  c) Channel markers, passing, signaling, etc.
  d) Distress signals

5. Safety Rules

  a) As applies to all "on-board" activities (integrated throughout instruction)
  b) Emergency procedures

6. Species of Common Commercial Fish

  a) Identification
  b) Use

7. Care and Handling of Fish

  a) Federal and state regulations
  b) Icing
  c) Loading and unloading techniques

8. Types of Fishing Gear

  a) Purse seine
  b) Otter trawl and beam trawl
  c) Gillnet
  d) Trolling and tuna fishing
  e) Reefnet
  f) Long-line (halibut fishing)
  g) Crab fishing

9. Assembling and Repairing Gear

  a) Lacing and hanging
  b) Mending web
  c) Net materials
  d) Mesh sizes

10. Marine Engines and Power Driven Equipment

  a) Starting and basic operating procedures
  b) Hydraulic units
  c) Safety rules

The instructional staff for the courses listed above consists of the following:

Evich, Joe, Instructor

To obtain further information, address inquiries to:

Admissions
Bellingham Vocational-Technical Institute
3028 Lindbergh
Bellingham, Washington 98225

BOSTON UNIVERSITY
MARINE BIOLOGICAL LABORATORY
Woods Hole, Massachusetts 02543

The Boston University Marine Program (BUMP) is a program in marine biological sciences primarily for graduate students but open to a small number of selected advanced undergraduates. It includes the following:

Basic courses in Marine Biology presented annually during the academic year (September-May) by BUMP faculty in residence at the Marine Biological Laboratory at Woods Hole.

Seminars in Marine Biology with the participation of BUMP faculty and visiting marine scientists.

Opportunities for research and for research training in marine problems, made possible by the availability of facilities at the MBL, on campus in Boston, and at the New England Aquarium in Boston.

Opportunities for qualified graduate students and undergraduates from other institutions to take courses and seminars in BUMP on a "eave of absence" basis from their home institution with academic credit available for transfer from the Boston University Graduate School.

A 65-foot vessel, R/V A.E. Verrill, and the library at the MBL, among the finest marine biological libraries in the country, are available to BUMP students.

The following degrees are offered:

1. A.M. in Biology, specializing in marine biology, requiring eight graduate-level semester courses (32 credit hours), a reading knowledge of one major modern foreign language (French, German or Russian), and the presentation of a master's thesis.

2. Ph.D. in Biology, specializing in marine biology, requiring successful completion of eight graduate-level semester courses (32 credit hours) beyond the A.M., a reading knowledge of one major modern foreign language (if not already demonstrated for the A.M.), successful completion of a qualifying examination, and presentation of a Ph.D. thesis, with an oral examination.

Exceptionally well-qualified candidates may be admitted to the Ph.D. program without the A.M. as a prerequisite. In such cases the A.M. thesis is waived.

Degrees offered: One A.M. and three Ph.D. degrees awarded in 1978-1979.

The following six-week intensive courses are offered:

BI 727X	Marine Invertebrate Zoology	6
BI 729X	Marine Ecology	6
BI 781X	Seminar in Marine Biology	2
BI 783X	Seminar in Marine Biology	2
BI 935X	Research in Marine Biology	-
BI 730X	Physiology of Marine Animals	6
BI 732X	Marine Microphytes	6
BI 782X	Seminar in Marine Biology	2
BI 784X	Seminar in Marine Biology	2
BI 936X	Research in Marine Biology	-

In addition, on campus in Boston the following related courses are offered:

BI 516	Marine Mammals	4
BI 520	Topics in Marine Zoology	4
GG 341	Ocean Resources and Marine Management	4
GG 541	Oceanography	4
GL 213	Coastal Environments I	4
GL 214	Coastal Environments II	4
GL 503	Marine Geology	4
GL 508	Coastal Processes	4
GL 533	Marine Paleoecology	4

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Atema, Jelle, Ph.D., Associate Professor
Golubic, Stjepko, Ph.D., Associate Professor
Humes, Arthur G., Ph.D., Professor, Director of BUMP
MacKay, Stuart, Ph.D., Professor
Tamm, Sidney, Ph.D., Associate Professor
Valiela, Ivan, Ph.D., Associate Professor

GEOGRAPHY

Batchelder, Robert B., Ph.D., Professor

GEOLOGY

Cameron, Barry W., Ph.D., Associate Professor
Fitzgerald, Duncan, Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. Arthur Humes, Director
Boston University Marine Program
Marine Biological Laboratory
Woods Hole, Massachusetts 02543
(617) 540-1979

BOWLING GREEN STATE UNIVERSITY
Bowling Green, Ohio 43403

Bowling Green State University offers courses in marine science within the framework of the Departments of Biological Sciences and Geology.

The Department of Biological Sciences is located in the modern Life Sciences Building which is well equipped with research and teaching instruments and facilities commensurate to a Ph.D. degree-granting department. The facilities include a sizeable marine laboratory equipped with numerous fiberglass aquaria of 10, 30, and 250 gallon capacity, refrigerated aquaria units, pH meters, precision balance, refractometer, temperature control incubators, refrigerators and a freezer. Additional equipment for research projects is available in the department. The department offers a number of aquatic oriented courses including a marine biology course with field trip and various marine seminars. The University is affiliated with the Gulf Coast Research Laboratory, Ocean Springs, Mississippi and with its summer courses in addition to those in the department, students can gain a background in marine biological science.

The Department of Geology maintains a marine science laboratory with aquariums and other equipment essential to growing small organisms. The department also has a paleobiology laboratory for the study of fossils, a sedimentology laboratory, a geochemistry laboratory, and an x-ray analysis facility. Research equipment includes grab samplers and coring devices, salinometer, portable pH meters, underwater photographic equipment, wet suits, water test outfits, sieve sets, plankton nets, settling tube, refrigerators, microscopes and photomicrographic equipment, microorganism culture equipment, and 11-foot boat with motor. The department maintains a houseboat as a field station at the Newfound Harbor Marine Institute, Big Pine Key, Florida. The marine geology course includes a two-week field trip to the marine environment, and a summer field course in modern marine environments if offered.

The Departments of Biology and Geology offer both the B.S. and the M.S. with concentrations in marine science. The following degrees are offered:

1. M.S. in Biology. Requirements 48-50 quarter hours (minimum) in biology, organic chemistry with laboratory required and biochemistry, calculus and physics recommended.

2. B.S. in Geology. Requirements: a student may elect to specialize in paleobiology.

3. M.S. in Biology or Geology. Requirements: 45 quarter hours minimum degree program and a formal thesis.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

Bio 108	Life in the Sea	4
Bio 201-203	Concepts in Biology	15
Bio 270	Marine Closed Systems	3
Bio 313	Bacteriology	5
Bio 350	General Genetics	5
Bio 401	Introduction to Biological Research	1-6
Bio 405	General Parasitology	5

Bio 408	Comparative Animal Physiology	5
Bio 409	Invertebrate Zoology I	5
Bio 410	Invertebrate Zoology II	5
Bio 411	Vertebrate Physiology	5
Bio 424	Algology	5
Bio 425	Limnology	5
Bio 431-433	Morphogenesis of Vertebrates I. Development II. & III. Comparative Anatomy	15
Bio 436	Cytology	5
Bio 472	Ichthyology	4
Bio 474	Marine Biology	5
Bio 475	Marine Field Trip	2
Bio 478-487	Courses at Gulf Coast Research Lab	
Bio 490	Seminar: Topics in Marine Biology	2
Bio 491	Readings: Topics in Marine Biology	2
Geo 302-303	Invertebrate Paleontology	8
Geo 307-308	Sedimentary Petrology and Stratigraphy	6
Geo 310	Geomorphology	4
Geo 480	Seminar in Geology	3
Geo 490	Geological Problems	1-4
Geo 412	Advanced Historical Geology	4
Geo 431	Introduction to Geochemistry	4
Geo 432	Geophysics	3
Geo 433	Stratigraphic Chorology	4
Geo 472	Marine Geology and Paleobiology	4
Geo 496	Field Course in Modern Marine Environments	9

GRADUATE

Geo 512	Sedimentology	5
Geo 513	Sedimentary Petrography	5
Bio 515	Comparative Physiology	5
Bio 516	Protozoology	5
Geo 523	Analysis of Sedimentary Structures	4
Geo 529	Advanced Invertebrate Paleontology	5
Geo 533	Paleoecology	5
Geo 535	Micropaleontology	5
Geo 538	Geochemistry of Sediments	5
Geo 540	Pleistocene Geology	5
Geo 546	X-ray Analysis	5
Geo 550	Research Seminar	1-5
Geo 551	Seminar in Invertebrate Paleobiology	3-5
Geo 552	Seminar in Paleobiology of Microorganisms	3-5
Geo 555	Seminar in Paleoecology	3-5
Geo 556	Seminar in Marine Sedimentation	3-5
Geo 557	Seminar in Geochemistry of Diagenesis	3-5
Geo 558	Seminar in Geomorphology and Pleistocene Geology	3-5
Bio 577	Problems in Marine Zoology	5-9
Geo 593	Advanced Field Geology	1-9
Geo 598	Research Problems	1-5
Geo 599	Thesis Research	1-9
Bio 599	Thesis Research	1-9

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Brent, Morgan M., Ph.D., Professor
Crang, Richard E., Ph.D., Professor
Groat, Cynthia S., M.A., Assistant Professor
Gromko, Mark H., Ph.D., Assistant Professor
Hallberg, Carl W., Ph.D., Professor
Horvath, Raymond, Ph.D., Associate Professor
Howard, Richard D., Ph.D., Assistant Professor
Lowe, Rex L., Ph.D., Professor
Martin, Elden W., Ph.D., Associate Professor
Rebalais, Francis C., Ph.D., Associate Professor
Schurr, Karl M., Ph.D., Professor
Thibault, Roger E., Ph.D., Assistant Professor
Vessey, Stephen H., Ph.D., Associate Professor
Woodruff, Ronny C., Ph.D., Assistant Professor

GEOLOGY

Hoare, Richard D., Ph.D., Professor
Kahle, Charles F., Ph.D., Professor
Pawlowicz, Edmund C., Ph.D., Associate Professor
Steinker, Don C., Ph.D., Professor
Walters, Lester J., Ph.D., Associate Professor

To obtain further information, address inquiries to:

Mrs. Cynthia S. Groat
Department of Biological Sciences
Bowling Green State University
Bowling Green, Ohio 43403

BRAZOSPORT COLLEGE
Lake Jackson, Texas 77566

Department of Oceanic and Marine Technology has shore laboratory facilities and major equipment at Lake Jackson, Texas. Regular classrooms average 576 square feet in area and are utilized on a flexible basis; i.e., drafting classroom equipped with drafting tables and stools are utilized for navigation classes, electronics laboratory and classrooms for marine electronics, etc., contingent upon project needs and classroom-laboratory availability. Office space specifically assigned to the project is programmed at 96 square feet and laboratory-bay areas at 3,072 square feet. Equipment in the categories of navigational, seamanship, engineering, marine electronics, diving, fire fighting, furniture and text and reference material are available to the project.

Research vessels include 65-foot steel hull twin diesel, up to 90-foot twin diesel mineral and oil type vessel. All these vessles are leased part-time.

The following degrees are offered:

1. Associate of Applied Science Degree, Marine Technology, sponsored by Oceanic and Marine Technology Department. A total of 74 credit hours are required for this two-year program.

2. Certificate of Courses Completed, Marine Technology, sponsored by Oceanic and Marine Technology Department. A total of 33 credit hours are required for this one-year program.

The following courses are offered in conjunction with the above programs:

OCEANIC AND MARINE TECHNOLOGY

First Semester

Ocean 102	Oceanography I	2
Ocean 104	Seamanship I	4
Ocean 124	Navigation I	4
Ocean 103	Oceanic and Marine Technology I	3
Ocean 123	Marine Engineering Technology I	3
		16

Second Semester

Ocean 114	Seamanship II	4
Ocean 134	Navigation II	4
Ocean 113	Oceanic and Marine Technology II	3
Elect 133	Fundamentals of Marine Electronics	3
Math 173	Technical Mathematics I	3
		17

Summer Semester

Ocean 106 - Oceanic and Marine Tech III (240 contact hours; six credit hours) (six week commercial-industrial practicum)

Upon completion of the first year, student is eligible for a certificate and immediate employment in industry; the student is prepared for U.S. Coast Guard examinations; completion of the program for the second year will lead to an Associate of Applied Science Degree; the summer semester is encouraged for certificate program students and required in the degree program.

Third Semester

Ocean 202	Oceanography II	2
Ocean 233	Navigation III	3
Bus 263	Marine Economics	3
Math 183	Technical Mathematics II	3
Phy 204	Technical Physics I	4
Eng 283	Marine Communications	3
		18

Fourth Semester

Ocean 203	Seamanship III	3
Ocean 223	Marine Engineering Technology II	3
Ocean 244	Oceanic and Marine Technology IV	4
Phy 214	Technical Physics II	4
Ocean 263	Marine Resources	3
		17

The instructional staff for the courses listed above consists of the following:

Bye, Richard, Ph.D., Associate Professor
Harkness, Warren, Ph.D., Assistant Professor
Robertson, Edward, Ph.D., Assistant Professor
Southward, Edgar, Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Richard Bye, Director
Oceanic and Marine Technology
Brazosport College
500 College Drive
Lake Jackson, Texas 77566

BROWN UNIVERSITY
Providence, Rhode Island 02912

Research and training in the marine sciences is undertaken at Brown in the Department of Geological Sciences. In addition to programs within the department, a cooperative effort in the marine sciences exists between Brown University and the Woods Hole Oceanographic Institution. As needed by individual students, cooperative programs of study and research programs operated jointly by Brown, Lamont-Doherty Geological Observatory and Oregon State University, the student has access to extensive collections of deep-sea cores. Ocean-going research is conducted with Woods Hole Oceanographic Institution.

Degrees offered:

1. A.B., Sc.B., in Marine Sciences. This is an independent concentration program structured in consultation with the departmental undergraduate advisor. Courses from chemistry, biology, geology, and physics are included.

2. M.Sc. in Geological Sciences, specializing in Marine Sciences. Requirements: Successful completion of an integrated program including a minimum of eight semester courses, no more than two of which shall be recearch courses, and demonstration of research capability.

3. Ph.D. in Geological Sciences, specializing in Marine Sciences. Requirements: Successful completion of course work and original thesis research.

UNDERGRADUATE

Geol 7	Introduction to the Ocean	4
Geol 28	Pollution and the Environment	4
Geol 112	Historical Oceanography	4
Geol 121	Oceanography	4
Geol 191, 192	Undergraduate Research	4

GRADUATE

Bio 284	Vertebrate Paleontology	4
Geol 219, 220	Seminar in Micropaleontology	4
Geol 223	Advanced Sedimentary Petrology	4
Geol 291	Special Topics	4
Geol 211	Thesis Research	4

The instructional staff consists of the following:

BIOLOGY

Quevedo, Walter, Ph.D., Professor

GEOLOGY

Berggren, William, Ph.D., Professor
Giletti, Bruno, Ph.D., Professor
Imbrie, John, Ph.D., Professor
Matthews, Robley, Ph.D., Professor
Prell, Warren, Ph.D., Assistant Professor (Res.)

To obtain further information, address inquiries to:

Dr. Warren Prell
Department of Geological Sciences
Brown University
Providence, Rhode Island 02912

CALIFORNIA MARITIME ACADEMY
Vallejo, California 94590

Located on the north shore of Carquinez Strait, 25 miles from San Francisco. California Maritime Academy was founded in 1929. It is supported by the State of California with supplemental funds from the U.S. Maritime Administration. Co-ed, 11 months per year for four years. Enrollment: 480.

The Academy offers two curriculums. One leads to a Bachelor of Science Degree in Nautical Industrial Technology. The other leads to the Bachelor of Science Degree in Marine Engineering Technology. Graduates serve as licensed deck or engineering officers in the U.S. Merchant Marine and also in shore-based maritime industry. The curriculums are directed primarily toward preparation for service as maritime officers, however, optional concentrations are available in Marine Transportation, Marine Business Management, Maritime Specialties, Instrumentation and Automation, Ocean Technology, Ship Construction Technology and Nuclear Technology.

A special facility is the training ship, Golden Bear, a 7,987 gross-ton vessel which can cruise at 16 knots and serves as a "floating laboratory" during the annual two-month training cruise.

Courses offered:

(Curriculum available in catalog)

Approximate number of degree recipients each year:

Marine Engineering - 55
Nautical Science - 55

Information on faculty is available in catalog.

To obtain further information, address inquiries to:

Director of Admissions
California Maritime Academy
Vallejo, California 94590

CALIFORNIA POLYTECHNIC STATE UNIVERSITY
San Luis Obispo, California 93407

The University is located in an area which offers students of marine sciences an unequaled, unspoiled variety of marine environments including open and protected rocky coastlines, mud and sand flats, sandy beaches, dunes and estuaries -- all within easy driving distance from the campus. A re-circulating sea-water system is maintained in the teaching laboratory, student research laboratory and faculty office-preparation room complex in the Science North building. A boat and gear storage building is adjacent, housing 17-foot and 14-foot outboard dories with trailers, overhead crane, net drying racks and gear storage lockers. Fishing boats at Morro Bay and Port San Luis are available for charter for open-water work. An extensive algal collection inventory of up-to-date scientific and photographic equipment is available for both undergraduate and graduate student research. The University computer facilities are also available for student use.

The following degrees are offered:

1. B.S. in Biological Sciences with a concentration in Marine Biology.

2. M.S. in Biological Sciences with an emphasis in Marine Biology.

BIOLOGICAL SCIENCES DEPARTMENT

Bio 328	Marine Biology	4
Bio 437	Marine Resources	3
Bio 524	Developmental Biology (Invertebrate Embryology)	3
Bot 337	Algology	4
Zoo 321	Mammalogy	4
Zoo 322	Ichthyology	4
Zoo 323	Ornithology	4
Zoo 336	Invertebrate Zoology	4
Zoo 432	Physiology II: Comparative Systems	4
Bio 461-	Senior Project	2
Bio 462	Senior Project	2
Bio 400	Special Problems	2
Bio 500	Individual Study	3
Bio 599	Thesis	9

PHYSICS DEPARTMENT

PHYSICS DEPARTMENT

Geo 321	Marine Geology	4
PSc 201	Introduction to Physical Oceanography	3
PSc 301	Physical Oceanography	3

BIOLOGICAL SCIENCES

Clogston, Fred L., Ph.D., Professor of Biological Sciences, Marine Biology
Fierstine, Harry L., Ph.D., Professor of Biological Sciences, Ichthyology
Johnson, Eric, Ph.D., Associate Professor of Biological Sciences, Ornithology
Kresja, Richard J., Ph.D., Professor of Biological Sciences, Ichthyology
Montgomery, David H., M.S., Professor of Biological Sciences, Invertebrate Zoology
Nakamura, Royden, Ph.D., Assistant Professor of Biological Sciences, Ichthyology
Richards, Thomas L., Ph.D., Professor of Biological Sciences, Marine Resources
Roest, Aryan, Ph.D., Professor of Biological Sciences, Marine Mammals
Sparling, Shirley, Ph.D., Professor of Biological Sciences, Algology

PHYSICAL SCIENCE

Balthaser, Lawrence H., Ph.D., Professor of Physics, Marine Geology
Chipping, David, Ph.D., Associate Professor of Physics, Marine Geology
Roach, David M., Ph.D., Professor of Physics, Physical Oceanography
Stowe, Keith S., Ph.D. Associate Professor of Physics, Physical Oceanography

To obtain further information, address inquiries to:

Head
Biological Sciences Department
California Polytechnical State University
San Luis Obispo, California 93407

CALIFORNIA STATE UNIVERSITY AND COLLEGES
MOSS LANDING MARINE LABORATORIES
Moss Landing, California 95039

Moss Landing Marine Laboratories is operated by a consortium of six of the California State University and Colleges (CSU Fresno, Hayward, Sacramento, San Francisco, San Jose and CSC Stanislaus) as a year-round center for upper division and graduate level education and research in the marine sciences. An average of 40 units of course work, plus master's research and thesis, are provided every term (fall and spring semesters, summer quarter). The Laboratories face west on Monterey Bay at the head of the Monterey Submarine Canyon, the largest such canyon on the west coast of the Americas. To the east, Moss Landing Harbor opens upon the diversified intertidal marsh and mudflat habitats of Elkhorn Slough. The buildings provide 14,000 square feet of classroom, research, laboratory, office and library space, equipped to support the diversified curriculum and research needs of a multidisciplinary operation. Skiffs and small boats (eight to 24 feet) provide access to the near-shore marine and estuarine environments upon which the Laboratories focus primary instructional and research emphasis. A 102-foot oceanographic research vessel, on contract to the Laboratories from the Navy, is used for deeper water instructional and research work on the continental shelf.

Since the Moss Landing Marine Laboratories are an integral part of six separate supporting institutions, degrees are earned through those schools. Baccalaureate and Master's degrees in the basic sciences (e.g., Biology, Chemistry, Geology, Meteorology) may include concentrations in the marine field, by including one or more semesters of study at the Laboratories. While details differ in the six institutions, the following general notes apply.

1. B.A. or B.S. in Biology, Botany, or Zoology. Marine sciences requirements at Moss Landing Marine Laboratories include general oceanography, marine science techniques, marine ecology, and quantitative marine science, plus electives appropriate to the major interest. In the California State University and Colleges, a minimum of 124 units are required for the bachelor's degree, of which 45 must be in broad general education areas.

2. B.A. or B.S. in Geology. The marine sciences concentration will be similar to that for Biology, with recommended electives including Marine Meteorology, Marine Biogenic Sedimentation, and Geological Oceanography.

3. M.A. or M.S. in Biology, Geology, Meteorology or Chemistry. Thirty graduate units, to include six to 10 units of required core courses, and research and thesis are required for the master's degree. Some institutions also require reading competence in a foreign language. The marine concentration usually includes a full year or more of work at the Moss Landing Marine Laboratories, with research and thesis on a marine environmental topic.

The Moss Landing Marine Laboratories curriculum supports two primary disciplines -- Marine Biology and Marine Geology -- for all six participating Universities and Colleges. Occasional course offerings also support majors in Meteorology (San Jose State University), Geography, and Engineering. Special summer workshops and year-round seminar courses are occasionally offered for in-service marine sciences instruction of teachers at all levels.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

101	General Oceanography	4
102	Marine Science Techniques	4
103	Marine Ecology	4
104	Quantitative Marine Science	3
105	Marine Science Diving	3
106	Subtidal Ecology	4
111	Zoology of Marine Vertebrates	4

112	Marine Birds and Mammals	4
113	Marine Ichthyology	4
121	Marine Invertebrate Zoology	4
122	Marine Invertebrate Embryology	4
123	Marine Invertebrate Physiology	4
131	Marine Phycology	4
132	Introduction to Marine Plankton	4
141	Geological Oceanography	3
142	Marine Biogenic Sedimentation	3
143	Coastal Geomorphology	3
151	Marine Meteorology	3
166	Marine Fisheries	4
171	Oceanographic Summer Cruise	4
172	Marine Environmental Group Research	3
175	Topics in Marine Sciences	3-4
177	Microscopic Techniques	3
180	Independent Study	1-4

GRADUATE COURSES

201	Concepts of Marine Science	3
202	Marine Instrumental Analysis	4
203	Advanced Marine Ecology	3
211	Behavior of Marine Animals	3
212	Topics in Marine Vertebrates	4
221	Topics in Marine Invertebrates	4
222	Biology of the Mollusca	4
231	Advanced Marine Phycology	4
232	Advanced Marine Plankton	4
241	Marine Microorganisms	3
242	Continental Drift and Biogeography	3
251	Marine Geochemistry	4
252	Topics in Marine Chemistry	4
261	Descriptive Physical Oceanography	4
271	Population Biology	3
273	Environmental Studies of Monterey Bay	3
277	Human Ecology of Monterey Bay	3
275	Advanced Topics in Marine Sciences	3-4
285	Graduate Seminar in Marine Biology	2
286	Graduate Seminar in Marine Geology	2
287	Graduate Seminar in Oceanography	2
298	Research in the Marine Sciences	1-4
299	Master's Thesis	1-4

The permanent instructional staff for the courses listed above consists of the following:

BIOLOGY

Cailliet, Gregor, Ph.D., Associate Professor
Foster, Michael, Ph.D., Associate Professor
Hurley, Ann C., Ph.D., Assistant Professor
Martin, John, Ph.D., Professor
Morejohn, G. Victor, Ph.D., Professor
Nybakken, James, Ph.D., Professor

GEOLOGY

Arnal, Robert E., Ph.D., Professor
Mullins, Henry, Ph.D., Assistant Professor

OCEANOGRAPHY

Broenkow, William, Ph.D., Professor

In addition to the permanent staff, there are usually several part-time and/or temporary personnel at the Laboratories every term.

To obtain further information, address inquiries to:

Dr. John H. Martin, Director
Moss Landing Marine Laboratories
P. O. Box 223
Moss Landing, California 95039

CALIFORNIA STATE UNIVERSITY AND COLLEGES
SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM
Long Beach, California 90801

Six California State Universities (Dominguez Hills, Fullerton, Long Beach, Los Angeles, Northridge, Pomona) have joined to provide an educational and research outlet for their growing marine programs. Presently, the Consortium has administrative offices in the Port of Long Beach. Future plans call for initial construction of a 30,000 square foot building along the water front in downtown Long Beach. Facilities will include laboratories with running seawater, constant temperature rooms, lecture rooms and offices.

SCOSC owns and operates the 50-foot vessel R/V Nautilus, a converted purse seiner with a range of 1,000 miles. The vessel is equipped with an Omega Navigator, radio/telephone, fathometer, oceanographic winch with 3,000 feet of cable, otter trawl, Isaacs-Kidd midwater trawl, plankton nets, dredges, corers, reversing thermometers, bathythermographs, D.O. and pH monitoring systems, Nansen bottles, dissecting microscope, Martek TDC, Secchi Disk, Avon inflatable boat, scuba equipment and diving platform. In addition the Consortium operates several small boats.

SCOSC is supportive to each member campus. Degrees are granted through the individual campuses. Degrees available at member institutions include:

Dominguez Hills

B.A. - Biological Science
M.A. - Biological Science
M.S. - Environmental Science

Fullerton

B.A. - Biological Science, Earth Science and Engineering
M.A. - Biological Science
M.S. - Engineering, Environmental Studies

Long Beach

B.A. - Biology
B.S. - Marine Biology, Geology, Earth Science, Microbiology, Zoology, Ocean Engineering
M.A. - Biology
M.S. - Geology, Microbiology

Los Angeles

B.A. - Biology, Microbiology, Geology
B.S. - Biology, Microbiology, Geology
M.S. - Biology, Microbiology, Geology

Northridge

B.A. - Biology, Earth Science
B.S. - Geology
M.S. - Geology, Biology and Engineering

Pomona

B.S. - Biology, Microbiology, Zoology, Earth Science, and Engineering
M.S. - Biology, Engineering

A large variety of marine-related courses are offered in conjunction with these degree programs at each of the member State Universities. It is a major goal of the SCOSC to offer new courses at the new facility. Below is a list of marine-related courses presently taught on our member campuses.

CALIFORNIA STATE UNIVERSITY (Northridge)

BIOLOGY DEPARTMENT

313	Invertebrate Zoology	3
315	Principles of Microbiology	4
322	Population Biology	3
416	Protozoology	4
419	Microbial Ecology	3
421	Marine Biology	3
422	Physiological Ecology	3

GEOLOGY DEPARTMENT

122	The World Ocean	4
300	Environmental Geology	2
322	Introductory Oceanography	4
421	Sedimentary Petrography and Petrology	4
422	Oceanography	4
424	Marine Geology	3
562	Chemical Oceanography	3
564	Advanced Marine Geology	3

ENGINEERING DEPARTMENT

121	Environment and Technology	2
385	Introduction to Air and Water Pollution Control	3
487	Water Pollution	3
493	Hydraulics	3
492	Ocean Engineering	3

CALIFORNIA STATE POLYTECHNIC UNIVERSITY (Pomona)

BIOLOGICAL SCIENCE DEPARTMENT

325	Principles of Ecology	4
400	Special Problems	1-2
418	Population Ecology	3
441	Internship in Biology	2
442	Marine Ecology	4
499	Special Topics	1-4
575	Advanced Topics in Biology	2
310	Microbiology	5

Botany

433	Phycology	4

Zoology

137	Invertebrate Zoology	5
350	Advanced Invertebrate Zoology	5
441	Ichthyology	4
450	Physiology of Marine Animals	4

EARTH SCIENCE DEPARTMENT

250	Environmental Geology	3
335	Physical Oceanography	3

ENGINEERING DEPARTMENTS

Egr 526	Hydrodynamics	4
Egr 567	Unit Processes in Waste Water Treatment	3
Egr 568	Biological Unit Processes in Waste Water Treatment	4
CE 332	Hydraulic Engineering	4
CE 431	Water Supply Engineering	4
CE 432	Water Quality Engineering	4
CE 451	Engineering Hydrology	4
CE 454	Water Quality Management	3
CE 455	Coastal Engineering	3
CE 456	Water Resources Development	4
EEE 230	Introduction to Nautilus Instrumentation	2
EEE 430	Ocean Engineering	4
EEE 434	Underwater Electronics	4

CALIFORNIA STATE UNIVERSITY (Long Beach)

BIOLOGY DEPARTMENT

201	Marine Natural History	3
313	Invertebrate Zoology	4
320	Ichthyology	3
325	Algae	3
350	General Ecology	3
416	Marine Biology	3
212	General Botany	3
452	Marine Plankton	4
455	Physiological Animal Ecology	3
464	Environmental Toxicology	3
490	Special Topics	2
496	Investigations in Biology	1-3
520	Advanced Ichthyology	2
550	Ecology of Marine Communities	3

GEOLOGY DEPARTMENT

160	Introduction to Oceanography	3
190	Environmental Geology	3
191	Air and Water Pollution	3
305	Resources and Man	3
342	Sedimentary Rocks	3
360	Principles of Oceanography	3
462	Elements of Physical & Chemical Oceanography	3
464	Geological Oceanography	3
490	Current Topics in Geological Sciences	3

Microbiology

441	Marine Microbiology	3

ENGINEERING DEPARTMENTS

Civil Engineering

437	Open Channel Hydraulics	3
438	Hydraulic Engineering Design I	3
439	Marine Civil Engineering I	3
464	Environmental Engineering	3
465	Water Environment Engineering	3
467	Water Resources Engineering	3
468	Marine Pollution Control	3
507	Port Engineering Management	3
521	Seaport Planning and Design	3
525	Airports and Harbors	3
532	Sediment Transportation	3
533	Coastal Hydrodynamics	3
534	Hydraulic Models	3
538	Hydraulic Engineering Design II	3

Electrical Engineering

265	Engineering for Ocean Environment	3
365	Ocean Engineering I	3
405	Special Topics	3
425	Underwater Instrumentation Systems	3
464	Underwater Sonics	3
465	Ocean Engineering Lab	1
466	Underwater Sonics II	3
467	Underwater Information Systems	3
565	Underwater Acoustics	3
566	Underwater Detection Systems	3

Mechanical Engineering

426	Corrosion Engineering	3
434	Waves and Currents	3
330	Engineering Thermodynamics I	3
336	Engineering Thermodynamics II	3

CALIFORNIA STATE UNIVERSITY (Dominguez Hills)

BIOLOGICAL SCIENCE DEPARTMENT

224	Microbiology	4
230	Population Biology	4
236	Environmental Biology	4
260	General Oceanography: Biological Marine Ecology	4
295	Selected Topics in Biology	2-4

CHEMISTRY DEPARTMENT

270	General Oceanography: Physical and Chemical	4
272	Marine Chemistry	4

GEOGRAPHY DEPARTMENT

210	Principles of Geomorphology	4
222	Contemporary Environmental Problems	4
284	Marine Geology	4
286	Structural Geology	4

CALIFORNIA STATE UNIVERSITY (Los Angeles)

BIOLOGY DEPARTMENT

426	Algae	4
452	Ichthyology	4
457A	Marine Invertebrate Zoology I	4
457B	Marine Invertebrate Zoology II	4
460	General Ecology	4
461	Fresh Water and Marine Botany	4
462	Plant Ecology	4
472	Marine Zoology	4
550	Topics in Animal Ecology	3
562	Advanced Topics in Plant Ecology	3

GEOLOGY DEPARTMENT

155	Oceanography	4
402	Sedimentary Petrology	4
562	Chemical Oceanography	4-5
564	Advanced Marine Geology	4-5

ENGINEERING DEPARTMENT

487	Hydraulics	4
589	Coastal Engineering	4
587	Hydraulics II	4
588	Hydraulic Structures	4

CALIFORNIA STATE UNIVERSITY (Fullerton)

BIOLOGICAL SCIENCE DEPARTMENT

102	Crisis Biology	3
316	Principles of Ecology	3
319	Marine Organisms and Their Environment	3
419	Marine Ecology	4
420	Biology of Marine Plankton	4
421	Biology of Marine Nekton	4
423	Pathogenic Microbiology	4
439	Microbial Ecology	4
446	Phycology	4
461	Invertebrate Zoology	4
475	Ichthyology	4
518	Seminar in Marine Science	3
517	Seminar in Ecology	3

Earth Science

335	General Hydrology	3
333	Oceanography	3
423	Advanced Sedimentology and Stratigraphy	3
431	Physical Oceanography	3
432	Marine Geology	3
435	Hydrogeology	3

ENGINEERING DEPARTMENT

207	Pollution and Politics	3
220	New Energy Sources	3
425A	Environmental Engineering	3
425B	Environmental Engineering	3
426	Ocean and Coastal Engineering	3
428	Engineering Hydraulics	3
435	Design of Water Systems	3
436	Engineering Hydrology	3
495	Technological Approaches to Environmental Problems	3
522	Hydrodynamic Lubrication	3
528	Environmental Fluid Mechanics	3
529	Open Channel Hydraulics	3
534	Surface Water Hydrology	3
539	Advanced Coastal Engineering	2

To obtain further information, address inquiries to:

Dr. Murray D. Dailey, Director
Southern California Ocean Studies Consortium
925 Harbor Plaza
P. O. Box 570
Long Beach, California 90801
(213) 437-0041, Ext. 366

CALIFORNIA STATE UNIVERSITY, FULLERTON
Fullerton, California 92634

California State University, Fullerton (CSUF), founded in 1957, is located on 225 acres in northern Orange County, approximately 35 miles southeast of Los Angeles. The University is the largest institution of higher education in rapidly-growing Orange County, currently enrolling in excess of 20,000 students. The campus is located within 30 minutes driving time of Newport Bay, an important habitat in Southern California for estuarine life, and 45-50 minutes of the rich rocky shorelines of the Irvine Coast and Laguna Beach.

The Department of Biological Science, which occupies approximately 50,000 square feet on two floors of the natural science building, offers undergraduate and graduate emphasis in Marine Biology. Additionally, the Department of Earth Science offers undergraduate coursework in Marine Geology and Oceanography. Facilities in the Department of Biological Science include several teaching and research laboratories, walk-in laboratory cold rooms, three darkrooms, two animal rooms, and a separate aquarium room. Also, electronics, wood and metal shops are available for use, as well as a greenhouse complex including outdoor ecological pens and tanks. Marine plant, invertebrate and fish collections are maintained for study. Two well-equipped 16-foot Boston Whaler vessels are utilized in teaching and research, along with a 52-foot converted fishing boat (R/V Nautilus), which is berthed in nearby Long Beach. Research equipment includes salinometers, oxygen analyzers, submarine photometers, pH meters, specific ion probes, spectrophotometers, liquid scintillation counters, and numerous environmental growth chambers, standard and inverted microscopes and cameras. Additionally, a large inventory of oceanographic sampling gear is available, e.g., neuston nets, otter trawl nets, seins, Isaac-Kidd midwater and Tucker Trawl nets, phytoplankton and zooplankton closing nets, Niskin bacteriological samplers, biological dredges and grabs, Phleger corer, Nansen and Van Dorn bottles equipped with reversing thermometers, depth recorders, and bathythermographs.

The Department of Biological Science offers the following degrees specializing in Marine Biology:

1. B.A. in Biological Science, with an emphasis in Marine Biology. A total of 124 units, including general education, 38 units in biological science, and supporting coursework in physical science and mathematics are required for the undergraduate degree. At least 18 elective units in upper division courses in biological science are required.

2. M.A. in Biological Science, with an emphasis in Marine Biology. A total of 30 units of advisor-approved coursework, at least 15 of which must be at the graduate level, are required for the degree, along with the successful completion and oral defense of a thesis or published paper covering a research problem.

The following elective courses are offered by the Department of Biological Science in conjunction with the undergraduate and graduate degree programs emphasizing Marine Biology.

UNDERGRADUATE COURSES

BIOL 401	Biogeography	3
BIOL 406	Biometry	4
BIOL 419	Marine Ecology	3
BIOL 419L	Marine Ecology Laboratory	1
BIOL 420	Biology of Marine Plankton	4
BIOL 421	Biology of Marine Nekton	4
BIOL 422	Intertidal Ecology	4
BIOL 446	Phycology	4
BIOL 461	Invertebrate Zoology	4
BIOL 464	Embryology	4
BIOL 475	Ichthyology	4
BIOL 480	Advanced Topics in Undergraduate Biology	1-3
BIOL 499L	Independent Laboratory Study	1-3

GRADUATE COURSES

BIOL 518	Seminars in Marine Science	3
BIOL 580	Advanced Topics in Graduate Biology	1-3
BIOL 598	Thesis	1-3
BIOL 599	Independent Graduate Research	1-3

The Department of Earth Science offers undergraduate coursework leading to the B.A. Degree:

B.A. in Earth Science, with an emphasis in Earth Fluids. Students may emphasize Meteorology or Oceanography within the general field of Earth Science. Of the 124 units required for graduation, 40 are to be taken in Earth Science and 37 in related fields.

UNDERGRADUATE COURSES

EAR SCI 333	Oceanography	3
EAR SCI 340	General Meteorology	3
EAR SCI 422	Invertebrate Paleontology	3
EAR SCI 431	Physical Oceanography	3
EAR SCI 432	Marine Geology	3
EAR SCI 440	Dynamic and Physical Meteorology	3
EAR SCI 499L	Independent Laboratory Study	1-3

The instructional staff for the courses listed above consists of the following:

BIOLOGICAL SCIENCE

Adams, Phillip A., Ph.D., Professor, Invertebrate Zoology
Horn, Michael H., Ph.D., Professor, Ecology and Functional Morphology of Marine Fishes

Lambert, Charles C., Ph.D., Professor, Reproductive Biology of Marine Invertebrates
Murray, Steven N., Ph.D., Professor, Ecology of Marine Algae
Seapy, Roger R., Ph.D., Associate Professor, Ecology of Marine Invertebrates

EARTH SCIENCE

Maloney, Neil J., Ph.D., Professor, Coastal and Shelf Processes

To obtain further information, address inquiries to:

Dr. Steven N. Murray
Department of Biological Science
California State University
Fullerton, California 92634
(714) 773-3614

CALIFORNIA STATE UNIVERSITY, LONG BEACH
Long Beach, California 90840

California State University, Long Beach has research facilities and teaching programs in marine science at the main campus and in cooperation with other California State Colleges and Universities, operates Southern California Ocean Studies Consortium. A 40-foot research vessel, *Tovan*, a 50-foot purse seiner, *Nautilus*, and a number of small crafts are available for field trips and related research activities. Courses are taught on campus in several departments and research projects are also conducted in departmental laboratories. Special research facilities, *e.g.*, current meter, salinometer, specific ion analyzer, atomic absorption spectrometer, carbon-sulphur analyzer, electron microscopes, gas chromatographs, water quality analyzer, Niskin bottles, nets, bottom samplers, and many other types of general laboratory equipment plus an inventory of modern electronic and acoustic systems are available.

The following degrees are offered:

1. Department of Geological Sciences

a) B.S. in Geology with emphasis in Marine Geology

1. Mathematics	12 credits
2. Chemistry	10 credits
3. Biology	5 credits
4. Geology	69 credits
5. Physics	8 credits

b) B.S. in Earth Science

1. Mathematics	3 credits
2. Physics	8 credits
3. Chemistry	10 credits
4. Astronomy	3 credits
5. Biology	3 credits
6. Geology	27 credits
7. Geography	3 credits

c) M.S. in Geology, specialization in Marine Geology and Environmental Science (minimum of 30 semester units of credits)

2. Biology Department

a) B.S. in Marine Biology

1. Mathematics	6 credits
2. Chemistry	13 credits
3. Physics	8 credits
4. Geology	3 credits
5. Biology	43 credits

b) M.S. in Biology, specialization in Marine Biology (minimum of 24 semester units of credits)

3. Electrical Engineering Department

a) B.S. in Engineering with Ocean Engineering option

1. Chemistry	5 credits
2. Physics	8 credits
3. Geology	3 credits
4. Mechanical Engineering	18 credits
5. Electrical Engineering	34 credits
6. Ocean Engineering Electives	9 credits
7. Science Electives	3 credits
8. Engineering Electives	8 credits
9. Civil Engineering	7 credits

b) M.S. in Engineering with specialization in Ocean Engineering (minimum of 30 semester unit of credits)

The following courses are offered in conjunction with the above program:

Geology 160	Introduction to Oceanography	3
Geology 191	Air and Water Pollution	3
Geology 460	Introduction to Geophysics	3
Geology 461	Introduction to Geochemistry	3
Geology 464	Geological Oceanography	3
Geology 465	Physical & Chemical Oceanography	3
Geology 466	Ocean Laboratory and Ocean Studies	1
Biology 417	Invertebrate Systematics	3
Biology 416	Marine Biology	3
Biology 452	Marine Plankton	3
Biology 313	Invertebrate Zoology	3
Biology 201	Marine Natural History	3
Elec. Eng. 365	Ocean Engineering I	3
Elec. Eng. 366	Ocean Engineering II	3
Elec. Eng. 425	Underwater Instrumentation Systems	3
Elec. Eng. 425L	Underwater Instrumentation Laboratory	1
Elec. Eng. 465	Underwater Sonics	3
Elec. Eng. 465L	Ocean Engineering Laboratory	1
Elec. Eng. 467	Currents Development in Ocean Engineering	3
Mech. Eng. 434	Ocean Waves and Currents	3
Civil Eng. 439	Marine Civil Engineering I	3
Civil Eng. 468	Marine Pollution Control	3

GRADUATE COURSES

Geology 662	Chemical Oceanography	3
Geology 664	Advanced Marine Geology	3
Biology 520	Advanced Ichthyology	2
Biology 550	Ecology of Marine Organisms	2
Biology 665	Seminar in Marine Biology	1
Civil Eng. 539	Marine Civil Engineering II	3
Elec. Eng. 565	Underwater Acoustics	3
Elec. Eng. 566	Underwater Detection Systems	3

The following courses are offered in conjunction with the 132-unit undergraduate requirement:

CE 205	Analytical Mechanics I	3
CE 206 or ME 205 or EE 140	Computer Methods I	2
CE 335	Fluid Mechanics	3
CE 336	Fluid Mechanics Laboratory	1
EE 210	Electric Circuits I	3
EE 210L	Electric Circuits I Laboratory	1
EE 310	Electric Circuits II	3
EE 330	Engineering Electronics I	3
EE 330L	Engineering Electronics I Laboratory	1
ME 330	Engineering Thermodynamics I	3
ME 331	Engineering Thermodynamics I Laboratory	1
ME 371	Analytical Mechanics II (Dynamics)	3
EE 265	Engineering for the Ocean Environment	3
EE 365	Ocean Engineering I	3
EE 366	Ocean Engineering II	3
EE 425	Underwater Instrumentation Systems	3
ME 373	Mechanics of Deformable Bodies	3
ME 426	Corrosion Engineering	3
CE 406	Engineering Economics and Administration	3
Geology 465	Elements of Physical and Chemical Oceanography	3
EE 463	Naval Architecture I	3
EE 464	Naval Architecture II	3
EE 465	Underwater Sonics I	3
EE 465L	Ocean Engineering Laboratory	1
EE 467	Current Developments in Ocean Engineering	3
EE 468	Basic Ship Design	3
EE 495	Ocean Structures	3
CE 439	Marine Civil Engineering	3
CE 464	Environmental Engineering	3
ME 434	Oceanographic Waves and Currents	3
ME 437	Intermediate Fluid Mechanics	3
ME 476	Engineering Vibrations	3
ME 477	Advanced Mechanics of Deformable Bodies	3

GRADUATE STUDIES IN OCEAN ENGINEERING

CE 407	Port Engineering Management	3
CE 532	Sediment Transportation	3
CE 533	Coastal Hydrodynamics	3
CE 534	Hydraulic Models	3
CE 536	Hydrology II	3
CE 536A, B	Marine Civil Engineering Laboratory	2, 2
CE 538	Hydraulic Engineering Design II	3
CE 539	Marine Civil Engineering II	3
CE 560	Environmental Engineering Laboratory	3
CE 562	Environmental Engineering Design I	3
CE 563	Environmental Engineering Design II	3
EE 565	Underwater Acoustics	3
EE 566	Underwater Detection Systems	3
ME 522	Fracture of Engineering Materials	3
ME 533	Mechanics of Real Fluids	3
ME 536	Analytical Thermodynamics	3
ME 576	Engineering Vibrations II	3

The instructional staff for the courses listed above includes the following:

CIVIL ENGINEERING DEPARTMENT

Bakker, T.P., M.S., Associate Professor
Chelapati, C.V., Ph.D., Chairman, C.E. Department
Chu, G.H., Ph.D., Assistant Professor
Dudley, J.H., M.S., Professor
Eshett, A., Ph.D., Associate Professor
Mostafa, M.G., Ph.D., Professor
Neidengard, C.A., M.S., Professor
Reed, W.H., M.S., Professor, Associate Dean

ELECTRICAL ENGINEERING DEPARTMENT

Hostetter, G.H., Ph.D., Professor
Jordanides, T., Professor, Chairman, E.E. Department
Lindquist, C.S., Ph.D., Professor
McDonald, A.W., Ph.D., Lecturer
Walther, J.A., M.S., Lecturer
Winchell, R.W., M.S., Professor

MECHANICAL ENGINEERING DEPARTMENT

Chu, Hsiao-Ling, Ph.D., Assistant Professor
Dyer, J.L., Ph.D., Professor
Edelman, W.E., Ph.D., Professor
Gilpin, C.B., Ph.D., Professor
Kyle, C.R., Ph.D., Professor
Mijares, E.R., M.S., Associate Professor
Roman, B.P., Ph.D., Professor
Tsao, C.H., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. Kwan-Ming Chan, Professor
Department of Geological Sciences
California State University
Long Beach, California 90840

Dr. Bert L. Conrey, Professor
Department of Geological Sciences
California State University
Long Beach, California 90840

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE
Northridge, California 91330

The campus is in the heart of the San Fernando Valley, less than a one-hour drive to the berth of the R/V Nautilus. The Nautilus, a 55-foot seiner, is equipped with A-frame and hydraulic winches, radar, Omega navigation system, and fathometer. The boat, owned and maintained by the Southern California Ocean Studies Consortium is utilized for class related field trips, research grant work, and graduate student research. Research equipment includes a complete seismic profiling system, gravity corer, Peterson and Shipek grab, bathythermographs, Nansen and Niskin bottles, Martek TDC meter, as well as other physical and biologic oceanographic sampling equipment and meters.

Campus facilities include three laboratories with a standard compliment of equipment (fume hoods, microscopes, glassware, and chemicals), core x-ray photographic unit, a well-equipped dark room, and facilities for maintaining living marine organisms.

The following degrees are offered:

1. B.S. in Geology. A degree with a possible concentration in Oceanography.

2. B.A. in Biology. A degree with several areas of concentration, with a possible minor in Marine Biology.

3. B.A. in Geography. A degree with a possible concentration in Climatology and with a possible minor in Oceanography.

4. B.A. in Earth Science. A degree with a possible concentration in Oceanography, or with a possible minor in Oceanography.

5. A minor program in Oceanography is available for all baccalaureate degrees. (30-32 credits)

6. M.S. in Geology. Thesis degree with possible emphasis in Oceanography. (30 credits)

7. M.S. in Biology. Thesis degree with possible emphasis in Marine Biology. (30 credits)

8. M.S. in Geography. Thesis degree with possible emphasis in Marine Climatology. (30 credits)

UNDERGRADUATE COURSES

Geos 122	The World Ocean	3
Geos 123	World Ocean Laboratory	1
Geos 322	Introductory Oceanography	4
Geos 422	Advanced Oceanography	4
Geos 424	Marine Geology	3
Geos 496	Topics in Geoscience Courses: 1) Continental Borderland 2) Marine Geophysics 3) Plate Tectonics	3
Biol 313	Invertebrate Zoology	3
Biol 325	Life in the Sea	3
Biol 326	Regional Excursions	1-3
Biol 392B	Field Studies in Invertebrate Zoology	1
Biol 404	The Algae	4
Biol 421	Marine Biology	3
Biol 429	Marine Ecology	3
Biol 492B	Field Studies in Marine Biology	1
Biol 492	Field Studies in Marine Ecology	1
Geog 310	Meteorology	3
Geog 311	Atmosphere	3
Geog 312	Climatology	3
Geog 468	Coastal Geomorphology	3
Geog 475	Historical Geography of the Sea	3
Engr 494	Ocean Engineering	3

GRADUATE COURSES

Geos 562	Chemical Oceanography	3
Geos 564	Advanced Marine Geology	3
Geos 570	Special Topics in Geology	3
Geos 598	Thesis or Graduate Project	1-6
Biol 500A-Z	Advances in Structural and Systematic Biology	1-3
Biol 520A-Z	Advances in Environmental Biology	1-3
Geog 581	Seminar in Climatology	3
Geog 583	Seminar in Meteorology	3

The instructional staff for the courses listed above consists of the following:

GEOLOGY

Akpati, Benjamin N., Ph.D., Associate Professor
Fischer, Peter J., Ph.D., Professor

BIOLOGY

Pohlo, Ross H., Ph.D., Professor
Segal, Earl, Ph.D., Professor

GEOGRAPHY

Court, Arnold, Ph.D., Professor
Henderson, David A., Ph.D., Professor
Howard, Robert B., Ph.D., Associate Professor
Lin, Gong-Yuh, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dean D.E. Bianchi
School of Science and Mathematics
California State University Northridge
Northridge, California 91330

or,

Any individual listed above
California State University Northridge
Northridge, California 91330
(213) 885-2004

CALIFORNIA STATE UNIVERSITY, SACRAMENTO
Sacramento, California 95819

The University offers marine science courses on the Sacramento campus in the Departments of Biological Sciences and Physics-Physical Sciences (as part of the curricula in Environmental Biology and Geology, respectively). The University also participates in the operation of the Moss Landing Marine Laboratories in Moss Landing, California (on Monterey Bay), as a part of a consortium of six California State Universities described in the Consortia section. The science departments at the University occupy a five-story building completed in 1967; the Biological Sciences Department occupies approximately one-and-one-half floors of space in this large building, as well as retaining the two-story building occupied earlier; these aggregate about 69,000 square feet of floor space, 45,000 in the larger building and 24,000 in the smaller. The Geology Department takes up approximately a half-story of space. Laboratories are modern and functional. The Biological Sciences Department maintains a 23-foot research inboard power cruiser and several smaller boats and the science building has salt water facilities. The Sacramento campus is located within an hour's drive of estuarine environments and within two hour's drive of the Pacific Ocean. The University has a library of approximately 700,000 total holdings, and is strong in science and technology, as is the nearby California State Resources Library.

The following degrees are offered:

1. B.A. in Biological Sciences. A broad based, normal 124 semester-unit baccalaureate degree. Chemistry, Physics, Mathematics, and Statistics are required as supporting subjects. For the marine sciences specialty Bio. Sci. 150, 162, 163 and Geology 101 are specified and Bio. Sci. 173 is recommended.

2. B.S. in Biological Sciences (Biological Conservation (Fish and Game)). This is a 132 semester-unit degree, which consists of the basic biology curriculum, with the addition of certain fish and game and other conservation courses.

3. M.A. in Biological Sciences. Students take several required courses in biological sciences, as well as supporting courses. A thesis is required. Certain courses and the thesis research can be done at Moss Landing Marine Laboratories.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF BIOLOGICAL SCIENCES

150	Invertebrate Zoology	3
115	Phycology	3
160	Ecology	3
161	Limnology	3
162	Ichthyology	3
163	Marine Ecology	3
165	Vertebrate Zoology	3
173	Principles of Fisheries Biology	3
273	Advanced Fishery Biology	3
196	Proseminar	2
282	Evolution	3
283	Biogeography	3
296	Seminar	2
199	Special Problems	2
299	Special Problems	2
500	Master's Thesis	2-4

DEPARTMENT OF GEOLOGY

101	General Oceanography	3
196	Seminar	1-4
199	Special Problems	1-3

Moss Landing Marine Laboratories offer approximately a dozen courses in this field, as well as seminars, workshops, and research.

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGICAL SCIENCES

Brittan, Martin R., Ph.D., Professor of Biological Sciences
Meeker, Gary L., Ph.D., Associate Professor of Biological Sciences
Schinske, Robert, M.S., Professor of Biological Sciences
Vanicek, C. David, Ph.D., Associate Professor of Biological Sciences

DEPARTMENT OF PHYSICS-PHYSICAL SCIENCES

Janke, Norman C., Ph.D., Professor of Geology
McGeary, David F. R., Ph.D., Associate Professor of Geology
Slaymaker, Susan, Ph.D., Assistant Professor of Geology

To obtain further information, address inquiries to:

Chairman
Department of Biological Sciences
California State University, Sacramento
Sacramento, California 95819

CAPE FEAR TECHNICAL INSTITUTE
Wilmington, North Carolina 28401

Cape Fear Technical Institute's Marine Division has training and both large and small vessel docking facilities at its main campus on the Cape Fear River in downtown Wilmington, 20 miles from the Atlantic Ocean. Physical facilities include several classrooms, laboratories and photographic darkroom and faculty and staff offices in the new seven-story wing of the Malcolm J. McLeod Building, woodworking and welding shops, net loft, and an oceanographic instrument lab on the Alton A. Lennon floating classroom barge, and several research training vessels, the 187-foot R/V Advance II, the 65-foot R/V Joanne, the 72-foot R/V North Star, and the 50-foot

M/V Limulus. The division also has 15 smallcraft ranging from 12 to 26 feet long. All large vessels are equipped with radar, radiotelephones, fathometers and Loran C. Scientific instrumentation used in the training program includes all types of classical oceanographic instrumentation, hydraulic winches, BT winches, salinometers, PDR's, Endeco current meters, CTD systems, photometers, sub-bottom profiling system, irradiameters, TDR's, photographic equipment, scuba equipment and cascade system, boomerang corer, flow meters, D.O. analyzers, pH meters, spectrophotometers (20, 88, P.E.AAS), specific ion analyzer, microscopes, incubators, auto claves, distillation equipment. The Marine Division also enjoys cooperative arrangements with the North Carolina Marine Resources Center, Ft. Fisher, North Carolina Division of Commercial and Sport Fishing Laboratory, North Carolina Division of Art, Culture and History Underwater Archaeology and Marine Preservation Laboratory and the International Nickel Company Frances L. LaQue Marine Corrosion Laboratory, all located within 20 miles of the CFTI campus.

The following degrees are offered:

1. A.A.S. in Marine Technology. This is an ocean-oriented scientific support program designed to prepare one for vocational and technical work in all aspects of the offshore industry. Eight weeks of shipboard training aboard a large vessel is the most unique requirement of this program. The approach is 'Hands-on'.

2. A.A.S. in Marine Laboratory Technology. This is a marine science oriented support program designed to prepare one for vocational and technical work in all except the offshore aspects of the industry. There is no shipboard training requirement. The approach in this program is also 'Hands-on'.

(NOTE: Revisions to both programs, to up grade them, are currently under consideration.)

MARINE TECHNOLOGY COURSES

T-BIO 131	Marine Biology I	3
T-MSC 107	Introduction to Oceanography	3
T-MSC 129	Power Boat Operations	3
T-MSC 121-8	Ship and Marine Equipment Repair	8
T-SHI 101-8	Ship Experience (as earned)	-
T-MSC 111	Introduction to Net Construction	3
T-CHM 101	Introduction to Chemistry	4
T-BIO 132	Marine Biology II	3
T-MED 120	First Aid	2
T-WLD 134	Marine Welding	2
T-MSC 101	Navigation I	3
T-MSC 112	Biological Net Construction I	3
T-BIO 110	Field Biology	3
T-CHM 109	Chemical Analysis of Natural Waters	3
T-PME 101	Marine Engines I	3
T-MSC 108	Oceanographic Instrumentation	3
T-MSC 202	Introduction to Data Acquisition	3
T-MSC 113	Biological Net Construction II	3
T-PME 101	Marine Engines II	2
T-EDP 201	Introduction to Computer Programming	3
T-MSC 102	Navigation II	3
T-ELC 107	Electricity I	5
T-MSC 205	Data Reduction Techniques	3
T-MAT 211	Basic Statistics	5
T-GEO 101	Marine Geology	4
T-PME 103	Marine Engines III	3
T-ELC 108	Electricity II	5
T-DFT 117	Drafting and Blueprint Reading	4
T-BIO 213	Marine Vertebrate Zoology	4
T-MSC 114	Fishing Methods	3
T-MSC 204	Advanced Oceanographic Instrumentation	1
T-ELN 204	Introduction to Marine Electronics	5
T-PME 104	Marine Engines IV	3
T-MSC 224	Chemical Oceanographic Sampling	2
T-PHO 110	Introduction to Photography	2

MARINE LABORATORY TECHNOLOGY COURSES

(All those listed for Marine Technology except those listed below.)

T-PME 102	Marine Engines II
T-MSC 121-8	Ship and Marine Equipment Repair
T-SHI 101-8	Ship Experience
T-MSC 112	Biological Net Construction II
T-MSC 202	Introduction to Data Acquisition
T-MSC 113	Biological Net Construction II
T-MSC 101	Navigation I
T-MSC 102	Navigation II
T-MSC 205	Data Reduction Techniques
T-PME 103	Marine Engines III
T-DFT 117	Drafting and Blueprint Reading
T-MSC 114	Fishing Methods
T-MSC 204	Advanced Oceanographic Instrumentation
T-PME 104	Marine Engines IV
T-MSC 224	Chemical Oceanographic Sampling

In addition to:

T-BIO 201	Aquarium Systems	3
T-MSC 117-119, 220-221	Practical Experience I-V	7
T-BIO 111	Microbiology	3
T-MSC 216	Oceanographic Data Processing	4
T-PHO 220	Advanced Photography	2
T-BIO 225	Marine and Freshwater Ecology	3

Basic Core Curriculum (Both Programs)

a) Statistics	5 credits
b) Technical English	12 credits
c) Technical Mathematics	15 credits
d) Sociology	9 credits
e) Physics	8 credits

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Carter, Marie S., A.A.S., Technician
Martin, James R., M.S., Instructor
Rhodes, S. Thomas, M.S., Instructor

OCEANOGRAPHY

Brandi, Raymond, B.S., Technician/Instructor
Foss, Edward L., M.S., Instructor

NAVIGATION, POWER BOAT HANDLING

Bryan, Joseph T., M.S., Instructor

NET CONSTRUCTION, PHOTOGRAPHY, PRACTICAL EXPERIENCE

Miller, Mark V., A.A.S., U.S.C.G., I.O. License, Instructor

FIRST AID

Brandi, Raymond, B.S., Technician/Instructor
Miller, Mark V., A.A.S., Instructor

MARINE ENGINES

McClelland, Roy, U.S.C.G. Ret., U.S.C.G.O.O License, Instructor

ELECTRICITY/ELECTRONICS

Price, Henry E., A.A.S., Instructor

To obtain further information, address inquiries to:

Registrar
Cape Fear Technical Institute
411 North Front Street
Wilmington, North Carolina 28401

or,

Ed Foss, Director
Marine Division
Cape Fear Technical Institute
411 North Front Street
Wilmington, North Carolina 28401
(919) 791-8122

CASE WESTERN RESERVE UNIVERSITY
Cleveland, Ohio 44106

The Department of Geology and the Division of Fluid, Thermal and Aerospace Sciences of the School of Engineering at Case Western Reserve University jointly administer an interdisciplinary program in Geophysical Fluid Dynamics.

The principal facilities are located on the Case Western Reserve campus as well as on the University-owned Squire Valleeview Farm about 10 miles east of the University. Among the experimental facilities are a low turbulence subsonic wind tunnel, a low turbulence water tunnel, a water table, as well as many small air and water flow facilities. The laboratories are well equipped with high precision flow and temperature measuring equipment including hot wire and hot film anemometers, a number of laser doppler velocity measurement devices. There are also water analysis facilities including analysis by radioactive tracers. Well-equipped, manned central shops and instrument rooms are available as well as a controlled environment room for experiments where extreme precision is important. A 25-acre watershed area at Squire Valleeview Farm is being used for a study of ecological system dynamics. Geophysical and oceanographic measurements in Lake Erie are made through cooperation with the U.S. Coast Guard. A Univac 1108 computer is available at the University's computing center.

The program itself is a graduate program leading to M.S. and Ph.D. degrees. The course requirements are as follows:

M.S. (Geophysical Fluid Dynamics). Six courses including EFTS 453 Geophysical Fluid Dynamics plus a thesis in the area of Geophysical Fluid Dynamics.

Ph.D. An additional eight to 10 courses including two Math courses, some in Physics, Geochemistry, etc., plus a doctoral dissertation.

Six M.S. and two Ph.D. degrees have been granted under the program since its inception in 1969. There are 10 students in the program in the 1972-1973 academic year.

The following courses are offered in conjunction with the above program:

EFTS 450	Analytical Fluid Mechanics
EFTS 452	Viscous Flow I
EFTS 453	Geophysical Fluid Mechanics I
EFTS 454	Theoretical Meteorology
EFTS 552	Viscous Flow II
EFTS 554	Turbulent Fluid Motion
EFTS 555	Approximation Methods in Engineering Analysis
EFTS 556	Geophysical Fluid Mechanics II
EFTS 557	Convection Heat Transfer
EFTS 558	Conduction and Radiation
EFTS 559	Kinetic Theory
EFTS 655	Theories of Hydrodynamic Stability
GEOL 321	Geology of Water Resources
GEOL 323	Applied Geophysics
GEOL 334, 335	Earth Environmental Science Seminar
GEOL 350	Geochemistry
GEOL 364	Descriptive Meteorology
GEOL 366	General Oceanography
GEOL 425	Geotectonics
GEOL 435	Geochemistry
GEOL 453	Physical Limnology

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Teraguchi, Mitsuo, Ph.D., Assistant Professor

FLUID, THERMAL AND AEROSPACE SCIENCES

Greber, Isaac, Ph.D., Professor
Janowitz, Gerald S., Ph.D., Assistant Professor
Kaplan, Shimon, Ph.D., Assistant Professor
Ostrach, Simon, Ph.D., Professor
Prahl, Joseph M., Ph.D., Assistant Professor
Reshotko, Eli, Ph.D., Professor

GEOLOGY

Fisher, Perry W., Ph.D., Assistant Professor
Helwig, James A., Ph.D., Assistant Professor
Hower, John, Ph.D., Professor
Lick, Wilbert J., Ph.D., Professor

To obtain further information, address inquiries to:

Professor Sam Savin, Chairman
Department of Earth Sciences
Case Western Reserve University
Cleveland, Ohio 44106

THE CATHOLIC UNIVERSITY OF AMERICA
Washington, D.C. 20017

The Institute of Ocean Science and Engineering was established at the University in 1967 to foster research and academic programs in the marine sciences. The major areas of marine-related research are: underwater acoustics, properties of transducers, structure and physical properties of salt water, marine cables, instrumentation, fluid dynamics, soil mechanics and physical properties of water laboratories. The University has participated in a cooperative program with three local Naval laboratories since 1967. This program sponsors mutual use of research facilities and oceanographic ships.

Computer facilities include IBM 1620 and 1130 computers and a PDP-10 computer. The University is a member of the Washington Consortium of Universities and The Marine Science Consortium of Pennsylvania Colleges and Universities. The University offers undergraduate and graduate programs at its main campus in northeast Washington, D.C. and at the Delaware Bay Marine Science Center of the Marine Science Consortium in Lewes, Delaware.

The following degrees are offered in Ocean Engineering and related fields:

1. D. Engr. or Ph.D. in Ocean Engineering (Department of Civil and Mechanical Engineering). Candidates for the doctorate in Ocean Engineering must satisfactorily complete two years of full-time resident graduate study beyond the master's degree or its equivalent on a part-time or three-quarter time basis. Degree requirements may be summarized as follows: a major course program (a minimum of 35 credit hours beyond the bachelor's degree), 18 credit hours in a minor field (usually Mathematics) or 12 credit hours in a first minor field and six credit hours in a second minor field, written comprehensive examinations in the major and first minor fields, a reading knowledge of one foreign language, a dissertation, and an oral defense of dissertation. Doctoral programs in Ocean Engineering are tailored to meet the needs of the individual student. Candidates may specialize in fluid or solid mechanics. Heat transfer or thermodynamics, control system or underwater acoustics. All doctoral candidates in Ocean Engineering must take a minimum of nine credit hours in pure or applied Oceanography, six one-semester upper-level graduate courses in their specialty area, and acquire appropriate at-sea experience.

2. M.S.E. in Ocean Engineering (Department of Civil and Mechanical Engineering). Candidates for the degree of Master of Science in Ocean Engineering are required to satisfactorily complete one year of full-time graduate study (a minimum of 24 credit hours including research and seminars), or its equivalent or a part-time on three-quarter time basis. A comprehensive examination in the major field plus a thesis is required. There are no foreign language requirements for the M.S.E. degree.

3. D. Engr. or Ph.D. in Engineering Acoustics (Department of Civil and Mechanical Engineering). Candidates for the Doctorate in Engineering Acoustics must satisfactorily complete two years of full-time resident graduate study beyond the master's degree, or its equivalent on a part-time or three-quarter time basis. Degree requirements may be summarized as follows: a major course program (a minimum of 35 credit hours beyond the Bachelor's degree), 18 credit hours in a minor field (usually Mathematics) or 12 credit hours in a first minor field and six credit hours in a second minor field, written comprehensive examinations in the major and first minor fields, a reading knowledge of one foreign language, a dissertation, and an oral defense of the dissertation.

4. M.S.E. in Engineering Acoustics (Department of Civil and Mechanical Engineering). Candidates for the degree of Master of Science in Engineering (acoustics) are required to satisfactorily complete one year of full-time graduate study (a minimum of 24 credit hours including research and seminars), or its equivalent on a part-time or three-quarter time basis. A comprehensive examination in the major field plus a thesis is required. There are no foreign language requirements for the M.S.E. degree.

5. B.S.E. (Ocean Engineering Option) (Department of Civil and Mechanical Engineering). Undergraduate students in this program follow the same curriculum as other mechanical engineering students during the freshman and sophomore years. Required Ocean Engineering courses in the junior and senior year are Engineering Properties of Materials, Physical Oceanography and Dynamic Measurements. The other required courses follow the C.M.E. curriculum. Projects related to Ocean Engineering are included in the laboratory and design courses. Fifteen semester hours of electives in the senior year may be selected from the list of Mechanical and Ocean Engineering courses at the senior and the beginning graduate level.

The following courses are offered in conjunction with the above programs:

GRADUATE COURSES

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

501	Structural Mechanics I	3
502	Structural Mechanics II	3
503	Introduction to Continuum Mechanics	3
504	Physical Oceanography	3
505	Advanced Design	3
506	Advanced Design	3
507	Introduction to Ocean Engineering	3
508	Ocean Waves	3
509	Materials for Ocean and Other Extreme Environments	3
511	Limit Analysis of Structures	2
512	Structural Analysis	3
514	Geological Oceanography	3
515	Structural Dynamics	3
517	Fundamentals of Instrumentation	3
532	Experimental Dynamics Laboratory	3
534	Experimental Stress Analysis	3
541	Classical Mechanics	3
545	Foundation of Fluid Mechanics	3
546	Inviscid Incompressible Flows	3
547	Inviscid Compressible Flows	3
548	Incompressible Viscous Flows	3
554	Applied Underwater Acoustics	3
561	Heat Transfer	3
562	Heat Transfer	3
564	Theory of Waves	3
565	Control System Analysis and Synthesis	3
566	Control System Analysis and Synthesis	3
568	Electromechanical Circuits and Transducers	2

571	Theoretical Thermodynamics	3
572	Theoretical Thermodynamics	3
581	Introduction to Acoustics	3
582	Environmental Noise and Its Control	2
597	Seminar	1
598	Seminar	1
701	Design of Complex Systems	3
702	Design of Complex Systems	3
704	Theory of Plasticity	2
705	Theory of Shells and Plates	3
706	Nonlinear Elasticity	3
707	Propagation of Sound in the Sea	3
708	Theoretical Elasticity	3
709	Radiation and Scattering I	3
710	Radiation and Scattering II	3
712	Acoustic Signal Processing	3
718	Stability of Structures	3
733	Viscous Gas Dynamics	3
734	Separation of Flow	3
735	Experimental Stress Analysis II	3
736	Experimental Stress Analysis III	3
741	Vibrations in Elastic Solids	3
742	Acoustic Radiation from Submerged Structures	3
743	Hypersonic Gas Dynamics	3
744	Hypersonic Gas Dynamics	3
768	Propagation in Random Media	3
797	Research	3
798	Research	3
995	Master's Dissertation Guidance	-
996	Master's Dissertation Guidance	-
997	Doctoral Dissertation Guidance	-
998	Doctoral Dissertation Guidance	-

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

Andrews, Frank A., Ph.D., Professor of Acoustics
Casarella, Mario J., Ph.D., Associate Professor of Ocean Engineering
Chang, Paul K., Ph.D., Professor of Fluid Mechanics
Chi, Michael, Ph.D., Professor of Structural Mechanics
Durelli, August J., Ph.D., Professor of Stress Analysis
Gilheany, John J., Ph.D., Associate Professor of Acoustics
Heller, Samuel R., Ph.D., Professor and Chairman of Civil and Mechanical Engineering (Ocean Engineering)
Jackson, Francis J., Ph.D., Adjunct Professor of Acoustics
Kelnhofer, William J., Ph.D., Associate Professor of Fluid Mechanics
Magrab, Edward B., Ph.D., Associate Professor of Acoustics
Parks, Vincent J., Ph.D., Associate Professor of Stress Analysis
Perrone, Nicholas, Ph.D., Adjunct Professor of Structural Mechanics
Smith, Rusell A., Ph.D., Associate Professor of Gluid Mechanics
Soteriades, Michael C., Ph.D., Professor of Structural Mechanics
Spooner, Ronald, Ph.D., Adjunct Professor of Acoustics
Thiruvengadam, Alagupillai, Ph.D., Associate Professor of Ocean Engineering
Tsao, Chi-Kung, Ph.D., Associate Professor of Heat Transfer
Vaishnav, Ramesh N., Ph.D., Professor of Structural Mechanics

DEPARTMENT OF AEROSPACE AND ATMOSPHERIC SCIENCES

Atabek, Bulent H., Ph.D., Professor of Fluid Mechanics
Chang, Chieh C., Ph.D., Professor and Chairman of Aerospace and Atmospheric Sciences (Atmospheric Vortices)
Eisler, Thomas J., Ph.D., Professor of Acoustics
Kao, Timothy W., Ph.D., Professor of Geophysical Fluid Mechanics
Lee, Kai F., Ph.D., Associate Professor of Atmospheric Physics
Ling, Sung C., Ph.D., Professor of Fluid Mechanics
Pao, Hsien P., Ph.D., Professor of Geophysical Fluid Mechanics
Whang, Yun C., Ph.D., Professor of Fluid Mechanics

To obtain further information, address inquiries to:

Dr. Mario J. Casarella
Institute of Ocean Science and Engineering
Catholic University of America
Washington, D.C. 20017

CHARLES COUNTY COMMUNITY COLLEGE
La Plata, Maryland 20646

Marine Sciences, a department of the Division of Biological Sciences, operates teaching and research facilities at Benedict, Maryland and at the main campus in La Plata, Maryland.

The Center for Marine and Estuarine Education at Benedict is located on the Patuxent River, an arm of the Chesapeake Bay. The Benedict Center, soon to be expanded to include residence facilities, is composed of four buildings. One building has been specifically equipped for physical and chemical studies while the others are geared for biological studies. Two research vessels, the R/V Truitt and R/V Menedia are based at Benedict and used in training cruises on the Patuxent River and Chesapeake Bay.

Facilities at the main campus include an aquatics lab, diving locker with 15 complete sets of scuba gear, environmental microbiology lab, chemical instrumentation lab, analytical water chemistry lab, and data processing center equipped with an IBM 370-165 computer. Specialized water quality equipment located at the main campus include infrared, ultraviolet, visible, and atomic absorption, spectrophotometers; gas chromatography; total carbon analyze; and pesticide monitoring units.

The Estuarine Resources Technology Program of the Department of Marine Sciences is designed to train personnel for all aspects of coastal zone research. Classroom and laboratory training is reinforced through practical field studies aboard the research vessels. A graduate of the ERT program will have the scientific skills to qualify for field and laboratory positions with the Federal and state government or with private industry.

The ERT program is well suited for students transferring to a four-year institution as the curriculum has been designed to maximize the transfer of academic credit. In addition, the exposure to all areas of physical, chemical, and biological marine research allows the student to choose their particular field of interest early in their academic training.

An Associate of Arts degree in Estuarine Resources Technology is granted students completing the 66 credit hour program.

The following schedule of courses must be completed to graduate in the above program:

Freshman Year - First Semester

BIO 101	Botany	4
BIO 110	Ecology	3
CHE 120	General Chemistry	4
ENG 101	Composition and Rhetoric	3
MTH 110	College Mathematics	3
		17

Freshman Year - Second Semester

BIO 102	Zoology	4
BIO 107	Inland and Coastal Aquatic Ecology	3
BIO 202	Marine Biology	3
CHE 121	General Chemistry	4
ENG 205	Report Writing	3
		17

Sophomore Year - First Semester

BIO 212	Introduction to Fisheries Biology	4
BIO 253	Aquatic Botany	3
CHE 252	Analytical Techniques in Water Chemistry	4
PED 201 or	Health	2
PED 221	Scuba Diving	2
Electives		3
		16

Sophomore Year - Second Semester

BIO 254	Aquatic Zoology	3
CHE 255	Instrumentation Lab	4
MTH 230	Statistics	3
SPH 101	Public Speaking	3
Electives		3
		16

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Billeter, Paul, Associate Professor
Cardano, Steven, Field Studies Coordinator
Poe, Thomas, Associate Professor

CHEMISTRY

Engel, William, Professor
Highby, John, Assistant Professor

To obtain further information, address inquiries to:

Mr. Thomas Poe, Director
Department of Marine Sciences
Charles County Community College
P. O. Box 910
La Plata, Maryland 20646

CITY UNIVERSITY OF NEW YORK
CITY COLLEGE OF NEW YORK
New York, New York 10031

The City University Institute of Marine and Atmospheric Sciences is the focus for a program in marine and atmospheric sciences that reaches out to many of the individual campuses of the City University of New York. The Institute is located at City College, and a 90-foot research vessel, the R/V Atlantic Twin, is based at Staten Island. Research facilities at City College include a weather station; laboratories specializing in microbial, planktonic, and benthic ecology; and laboratories specializing in meteorology, satellite oceanography, sedimentation and hydraulics. City College and City University maintain cooperative arrangements with the American Museum of Natural History, the Lamont-Doherty Geological Observatory, the Osborne Marine Laboratory, and other research facilities.

The following degree programs exist in conjunction with the above programs:

1. Bachelor of Science (Biology, Chemistry, Physics, Earth and Planetary Sciences). Undergraduate students major in one of the above disciplines, and may elect to take undergraduate and some graduate courses in marine and atmospheric sciences. A program in meteorology is an interdisciplinary effort of the Earth and Planetary Sciences and Physics Departments.

2. Master of Arts (Biology, Earth and Planetary Sciences). Students must complete 30 credits of an approved program of study with a grade of B or better, including a research thesis. Areas of specialization include Biological, Physical and Geological Oceanography, and Meteorology.

3. Doctor of Philosophy. A program in Biological Oceanography is centered at City College, but course offerings and faculty advisors also exist at Lehman, Brooklyn, Queens and Hunter Colleges. Students must complete 60 credits of an approved program, including dissertation study. In addition, students must pass a written comprehensive examination, an oral examination centered about the thesis proposal, a proficiency examination in one foreign language or computer, and the defense of thesis. A Ph.D. in Physical Oceanography and Meteorology is obtainable under the Fluid Geophysics option in Physics. The program is centered at City College. Degree requirements are generally the same as for Biological Oceanography.

The following courses are offered at City College in conjunction with the above programs:

UNDERGRADUATE COURSES

Bio	274	Biological Oceanography	4
(EPS)	68	Chemical Oceanography	4
EPS	42, 43	Synoptic Meteorology	8
EPS	51	Statistical Methods in Meteorology	4
EPS	53	Weather Forecasting	4
EPS	64	Physical Oceanography	4
EPS	65	Marine Geology	4
EPS	90-94	Selected Topics in Geology and Geological Oceanography	12
EPS	95-99	Selected Topics in Meteorology and Physical Oceanography	12
Phys	55	Physical Meteorology	3
Phys	56	Dynamic Meteorology	3
Phys	57	Physics of the Upper Atmosphere	3
Bio	761.1, 2	Marine Plankton Dynamics	6
Bio	761.3, 4	Marine Benthos	6
Bio	761.5, 6	Fishes and Fisheries Biology	6
Bio	761.7, 8	Marine Microbiology	6
EPS	1700	Fundamentals of Atmosphere and Oceans	3
EPS	1721	Pollution Factors in the Atmosphere and Hydrosphere	3
EPS	1768	Physical Oceanography I	3
EPS	1769	Physical Oceanography II	3
EPS	1774	Numerical Weather Prediction 1	3
EPS	1775	Numerical Weather Prediction 2	3
EPS	1776	Statistical Methods in Meteorology and Oceanography	3
EPS	1777	Principles of Atmosphere and Ocean Dynamics	4
EPS	1780	Tropical Meteorology	3
EPS	1781	General Circulation of the Atmosphere	3
EPS	1782	Oceanography for Engineers	3
EPS	1783	Oceanography and Space Technology	3
EPS	1784	Oceanographic Field Research	4
EPS	1788	Climate and Climate Change	3
EPS	1789	Physical Meteorology	3
EPS	1790	Special Topics in Meteorology and Oceanography	3

The instructional staff for the courses of study outlined above consists of:

POLICY COUNCIL OF THE INSTITUTE OF MARINE AND ATMOSPHERIC SCIENCES

Coch, Nicholas K., Ph.D., Professor of Earth and Environmental Sciences, Queens College
Meeks, Thomas, Ph.D., Professor of Physics, Kingsborough Community College
Pierson, Willard J., Ph.D., Professor, Institute of Marine and Atmospheric Sciences
Rachlin, Joseph W., Ph.D., Professor of Biology, Lehman College
Tietjen, John H., Ph.D., Professor of Biology, City College
Weiss, Dennis, Ph.D., Assistant Professor of Earth and Planetary Sciences, City College

BIOLOGY

Be, Allan, Ph.D., Adjunct Professor of Biology
Franz, David, Ph.D., Associate Professor of Biology, Brooklyn College
Gallagher, Jane, Ph.D., Assistant Professor of Biology
Lee, John J., Ph.D., Professor of Biology
Malone, Thomas, Ph.D., Adjunct Professor of Biology
Powers, Lawrence, Ph.D., Assistant Professor of Biology
Pierce, Stanley, Ph.D., Professor of Biology, Queens College
Rachlin, Joseph, Ph.D., Professor of Biology, Lehman College
Roze, Janis, Ph.D., Associate Professor of Biology
Smith, C.L., Ph.D., Adjunct Professor of Biology
Tietjen, John H., Ph.D., Professor of Biology

CHEMISTRY

Haines, Thomas H., Ph.D., Professor of Chemistry

EARTH AND PLANETARY SCIENCES

Coch, Nicholas, Ph.D., Professor of Earth and Environmental Sciences, Queens College
Fagen, John, Ph.D., Associate Professor of Earth and Planetary Sciences
Franke, Lehn, Ph.D., Associate Professor of Earth and Planetary Sciences
Gedzelman, Stanley, Ph.D., Associate Professor of Earth and Planetary Sciences
Harris, William, Ph.D., Associate Professor of Geology, Brooklyn College
Neumann, Gerhard, Ph.D., Professor of Earth and Planetary Sciences
Pierson, Willard J., Ph.D., Professor of Oceanography
Spar, Jerome, Ph.D., Professor of Earth and Planetary Sciences
Weiss, Dennis, Ph.D., Assistant Professor of Earth and Planetary Sciences

To obtain further information, address inquiries to:

Dr. John H. Tietjen, Director
Institute of Marine and Atmospheric Sciences
City College of New York
Convent Avenue at 138 Street
New York, New York 10031

THE CITY UNIVERSITY OF NEW YORK
QUEENS COLLEGE
Flushing, New York 11367

Queens College is a part of the City University of New York and oceanographic studies at all levels through the Ph.D. are coordinated through the Institue of Oceanography of the City University. Queens College offers a number of programs with oceanographic orientation on the undergraduate level and also grants an M.A. degree in Marine Geology.

The College has use of institute facilities, including the 90-foot research vessel Atlantic Twin, a wide range of equipment for oceanographic research and dock-side laboratories at St. George, Staten Island. Research equipment at Queens College includes instruments for stable and radioisotope studies, an atomic absorption spectrometer, infrared gas analyzers, gas chromatographs and x-ray diffraction and spectrometry equipment. A wide range of other equipment for chemical, biological and geological investigations is also available in the laboratories of the college.

The B.A. degree (128 credits) may be achieved in several ways:

1. A major in one of the sciences or mathematics and nine or more credits in oceanography courses. A student wishing to become a physical oceanographer should major in physics or mathematics. A student with interests in marine engineering may begin with pre-engineering programs at the College.

2. A choice of two programs may be made through the Department of Earth and Environmental Sciences:

a) For students with an interest in scientific aspects of oceanography or oceanographic education, 18 credits from within the department and at least 15 credits of advanced science courses appropriate to the student's goals from other departments.

b) For students in social aspects of oceanography, admiralty and marine law, science journalism and the like, 18 credits from within the department and 15 credits of advanced work appropriate to the student's goals in one other department.

3. For exceptional students with more than usually well-defined goals, individually tailored programs may be arranged through the Honors and Interdisciplinary Studies Program.

The M.A. in Marine Geology includes the following requirements: 30 credits of approved graduate courses including structural geology and a field course, a written dissertation and oral defense, a reading knowledge of an approved foreign language, and a written comprehensive examination.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

EES 8	Introduction to Oceanography	3
EES 55	General Oceanography	3
EES 56	Physical and Chemical Oceanography	3
EES 57 (Bio 57)	Principles and Practice of Oceanographic Research	3
Bio 56	Marine Biology	3
Phys Ed 5	Aquatics	various

GRADUATE COURSES

EES 507	Oceanography of New York and Adjacent Waters	3
EES 780	Marine Geology	3
EES 773	Low Temperature Geochemistry	3
EES 740	Sedimentology	3
EES 757	Geomorphic Processes	3

The instructional staff for the courses listed above consists of the following:

EARTH AND ENVIRONMENTAL SCIENCES

Coch, Nicholas, Ph.D., Professor
McIntyre, Andrew, Ph.D., Professor
Schreiber, Edward, Ph.D., Professor
Thurber, David, Ph.D., Professor

CHEMISTRY

Locke, David, Ph.D., Professor

BIOLOGY

Pierce, Stanley, Ph.D., Associate Professor

HEALTH AND PHYSICAL EDUCATION

Loret, John, Ed.D., Associate Professor
Magel, John, Ph.D., Professor
McArdle, William, Ph.D., Professor

To obtain further information, address inquiries to:

Chairman
Department of Earth and Environmental Sciences
Queens College
Flushing, New York 11367

CLARK UNIVERSITY
Worcester, Massachusetts 01610

Clark University offers graduate and undergraduate programs for those interested in the marine sciences. The programs offer a broad base of essential courses in marine studies and research training under the guidance of specialists in the marine environment and related fields. A course of study is designed by each student in consultation with a faculty advisor to permit flexibility and to maximize the opportunities available to each student. A variety of modern research instruments are available to students for use in their research.

The participants in the marine science program at Clark University have ready access to the cooler waters north of Cape Cod and the warmer waters south of it, which combined provide a great deal of diversity in physical and biological parameters. Cooperative arrangements are made for study and research at a number of marine laboratories. These include particularly the Marine Biological Laboratory at Woods Hole and the Bermuda Biological Station laboratory in the mid-Atlantic.

The following degrees are offered:

1. B.A. in Biology

a) Biology	8 courses
b) Chemistry	2 courses
c) Physics	2 courses
d) Mathematics	2 courses
e) Geology or Advanced Chemistry	2 courses

2. B.A. in Student-Designed Major

Students in consultation with a faculty advisory committee may design his or her own program of study in the marine sciences. Courses in marine sciences are available in the departments of Biology, Chemistry, Geography and Geology.

3. M.S. in Biology

The student must complete 10 courses, at least four of which are research courses, beyond the B.A. degree that are relevant to marine sciences and agreed upon by the student and his or her faculty advisor. An acceptable thesis is required which the student must defend during a two-hour oral examination.

4. Ph.D. in Biology

The student must complete 16 courses, eight of which are research courses, beyond the M.A. degree and complete an acceptable thesis which must be defended during a two-hour oral examination. A reading knowledge of one foreign language is required.

The following courses are offered in conjunction with the above programs:

*Bio.	101	Paleozoology
*Bio.	106	Botany of the Maine Coast
*Bio.	107	Marine Ecology of Bermuda
*Bio.	113	Algae and Fungi
*Bio.	114	Phycology
*Bio.	117	Principles of Ecology
Bio.	212	Seminar in Plant Ecology
Bio.	214	Seminar in Phycology
Bio.	215	Invertebrate Zoology
Bio.	216	Field Ecology
Bio.	217	Marine Biology
Bio.	260	Directed Research
Bio.	261	Directed Readings
Bio.	291	Quantitative Methods for Biology
Bio.	300	Readings and Research in Biology
Bio.	317	Microclimatology and Biometeorology
Bio.	335	Seminar in Environmental Systems
Bio.	350	Graduate Seminar
Bio.	360	Master's Thesis
Bio.	390	Doctoral Thesis
*Chem.	142	Environmental Chemistry
Chem.	335	Natural Products
*Geol.	11	Introduction to Physical Geology
*Geol.	171	Environmental Geology

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Johnson, S.E., Ph.D., Assistant Professor
Johansen, H.W., Ph.D., Associate Professor
Nunnemacher, R.F., Ph.D., Professor

GEOLOGY

Rehmer, J., Ph.D., Assistant Professor

CHEMISTRY

Erickson, K.L., Ph.D., Associate Professor
Jones, A.A., Ph.D., Assistant Professor

GEOGRAPHY

Howard, R.A., Ph.D., Assistant Professor
Lewis, L.A., Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. R.F. Nunnemacher, Chairman
Department of Biology
Clark University
Worcester, Massachusetts 01610

CLATSOP COMMUNITY COLLEGE
Astoria, Oregon 97103

Clatsop Community College, the only two-year institution in Oregon providing comprehensive maritime technical training, has participated since 1968 in the National Sea Grant Program in cooperation with Oregon State University. The geographic location of Clatsop Community College, 12 miles from the Pacific Ocean on the Columbia River, is most advantageous for providing the needed resources for successfully conducting the program. The Columbia River is extremely well suited for preliminary training in seamanship, commercial fishing, and oceanographic techniques. The area provides sheltered water for training in techniques of handling instruments, plankton tows, water sampling, salinity tests, etc. Proximity to the Pacific Ocean is an important asset for training the more advanced students in oceanographic techniques as well as extensive commercial fishing practicums.

Oceanography indoor classes are held in a specially designed facility located on the main campus. Commercial Fishing and Marine Technology indoor classes are held at the old Astoria Yacht Club, located on the shores of Youngs Bay, approximately one mile south of the main campus. Much of the laboratory work is conducted on one of the College's boats. The College operates two boats, one is 55 feet long and the other is 21 feet long. The M/V

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* These courses, which are primarily undergraduate courses, may be taken for graduate credit upon completion of additional work.

Forerunner, a 55-foot steel hull, commercial fishing vessel, is fully equipped with electronics including sonar, radar, and Loran. In addition, it is rigged for dragging, trolling (tuna and salmon), longlining and crabbing. A boom and other gear have been added to complement oceanographic research activities.

The following degrees are offered:

1. Associate in Science

a) Ninety credits minimum of approved coursework.
b) Cumulative grade point average of 2.00 or above for all college-level work.
c) Six credits minimum of communications courses.
d) Six credits minimum of social science courses.
e) Six credits minimum of math or science.
f) Required courses prescribed for specific major curriculum.
g) Attendance at Clatsop Community College at least two terms (including the last term before the Associate in Science degree is awarded).
h) One credit physical education (unless excused).
i) Three credits personal health or advanced first aid.

2. Associate in General Studies

Same as Associate in Science, except a student does not have to complete all required courses prescribed for the specific major curriculum. Students desiring an "emphasis in" degree must complete two-thirds of the credits of required courses prescribed for that program.

The following programs are offered:

ASSOCIATE IN SCIENCE, OCEANOGRAPHIC TECHNOLOGY

First Year

3.506	Seamanship for Oceanographers	4
3.512	Marine Biology I	4
3.514	Marine Biology II	4
3.662	General Oceanography I	4
3.664	General Oceanography II	4
3.666	General Oceanography III	4
Mth 95	Intermediate Algebra	4
	Social Science Electives	6
WR 121	English Composition	3
WR 122	English Composition	3
HE 250	Health	3
or		
HE 252	First Aid	3
	Recommended Electives	4-8

Second Year

3.408	Ocean Techniques I	4
3.410	Ocean Techniques II	4
3.412	Ocean Techniques III	4
Ph 201	General Physics	4
Ph 202	General Physics	4
Ch 201	General Chemistry	4
Ch 202	General Chemistry	4
Ch 203	General Chemistry	4
	Physical Education	1
	Recommended Electives	6-10
Ph 203	General Physics	4

ASSOCIATE IN SCIENCE, MARINE TECHNOLOGY

First Year

3.388	Marine Shop Practices I	3
3.389	Marine Shop Practices II	3
3.500	Seamanship I	4
3.502	Seamanship II	4
3.504	Seamanship III	4
3.510	Marine Electricity I	4
3.511	Marine Electricity II	4
3.515	Marine Electronics I	4
4.165	Marine Welding I	3
4.166	Marine Welding II	3
	Mathematics	6-8
	Social Science	3

Second Year

3.321	Hydraulics and Pneumatic Systems I	3
3.524	Boat Maintenance and Repair	3
3.531	Marine Refrigeration Systems I	3
3.800	Diesel Engines I	3
3.802	Diesel Engines II	3
HE 250	Health	3
or		
HE 252	First Aid	3
	Communications	6
	Social Science	3
	Physical Education	1
	Recommended Electives	18

ASSOCIATE IN SCIENCE, COMMERCIAL FISHING TECHNOLOGY

First Year

3.500	Seamanship I	4
3.502	Seamanship II	4
3.504	Seamanship III	4
3.510	Marine Electricity	4
3.515	Marine Electronics I	4
3.521	Commercial Fishing Techniques I	4
3.522	Commerical Fishing Techniques II	4
3.523	Commerical Fishing Techniques III	4
3.524	Boat Maintenance and Repair	3
3.526	Economics of Commercial Fishing V	3
3.530	Marine Food Preparation and Storage	2
3.800	Diesel Engines I	3
3.802	Diesel Engines II	3
5.211	Standard First Aid with CPR	2
	Social Science	3
	Physical Education	1

Second Year

3.321	Hydraulic and Pneumatic Systems I	3
3.400	Cooperative Work Experience	8
3.401	Job Search Techniques	1
3.525	Advanced Commercial Fishing IV	4
3.531	Marine Refrigeration Systems I	3
3.620	Navigation (Practical)	3
4.165	Marine Welding I	3
4.166	Marine Welding II	3
HE 250	Health	3
or		
HE 252	First Aid	3
	Social Science	3
	Communications	6
	Mathematics or Science	6-8

RECOMMENDED ELECTIVES (Oceanographic Technology)

Mth 101	College Algebra	4
Mth 102	Trigonometry	4

Mth 103	Statistics	4
BA 131	Introduction to Business Data Processing	3
Mth 233	Introduction to Numerical Computation	4
3.401	Job Search Techniques Seminar	1
3.402	Job Search Techniques Seminar	1
3.403	Job Search Techniques Seminar	1
3.400	Cooperative Work Experience	1-15
3.510	Marine Electricity I	4
3.511	Marine Electricity II	4
4.101	Drafting I	2
Art 291	Drawing	3
0.519	Photography (Basic)	-
GL 50	German	4
RL 50	French	4
RL 60	Spanish	4
3.380	Machine Tools I	3
3.381	Machine Tools II	3
3.382	Machine Tools III	3
4.165	Marine Welding I	3
4.166	Marine Welding II	3
3.620	Navigation	3
4.133	Industrial and Marine Construction Practices	3
3.502	Seamanship II	4
3.504	Seamanship III	4
G 201	Geology	3
G 202	Geology	3
G 203	Geology	3
G 204	Geology Lab	1
G 205	Geology Lab	1
G 206	Geology Lab	1

RECOMMENDED ELECTIVES (Commercial Fishing and Marine Technology)

3.521	Commercial Fishing Techniques I	4
3.522	Commercial Fishing Techniques II	4
3.523	Commercial Fishing Techniques III	4
(NOTE:	Commercial Fishing Techniques I-III is limited to Marine Technology students only)	
3.339	Blueprint Reading and Sketching	3
3.382	Machine Tools III	3
BA 131	Introduction to Business Data Processing	3
6.137	Computation Methods I	1
4.101	Drafting I	2
3.400	Cooperative Work Experience	1-15
3.401	Job Search Techniques Seminar	1
3.402	Job Search Techniques Seminar	1
3.403	Job Search Techniques Seminar	1
Mth 95	Intermediate Algebra	4
3.360	Power Systems	2
3.668	Commercial Fishing Seminar	3
6.257	Radio Station Operators Lab	3
3.620	Navigation	3
3.507	Charter Boat Deckhand	3

Other electives may be recommended

The instructional staff for the courses listed above consists of the following:

OCEANOGRAPHIC TECHNOLOGY

Muehlberg, Gary, M.S., Instructor

MARINE TECHNOLOGY

Itzen, Eugene, M.S., Instructor and Director, Career Planning and Employment

Killion, Patrick, B.S., Instructor and Coordinator, Maritime Sciences Department

Perkins, Dale, B.T., Instructor

Petersen, Ken, M.S., Instructor

COMMERCIAL FISHING TECHNOLOGY

McMullen, Scott, Instructor

OTHER

Phillips, David W., M.F., Assistant Dean of Instruction; Director, Sea Grant Programs

To obtain further information, address inquiries to:

Mr. James Hogan
Director of Admissions and Records
Clatsop Community College
16th and Jerome
Astoria, Oregon 97103

CLEMSON UNIVERSITY
Clemson, South Carolina 29631

Clemson University offers programs in the College of Agricultural Sciences, the College of Sciences, and The Belle W. Baruch Forest Science Institute which is administered by the College of Forest and Recreation Resources.

The Belle W. Baruch Forest Science Institute of Clemson University sponsors research and education programs in areas related to marine science. Current research involves dune stabilization, spoils bank reclamation, flora and fauna of rice fields, fresh-water marshes, and management of maritime forests for optimum aesthetic and productive values. The Institute manages 7,500 acres encompassing all of the habitats mentioned above.

In addition to the facilities of the Belle W. Baruch Forest Science Institute at Georgetown, South Carolina, Clemson University utilizes facilities at Morehead City, North Carolina and Charleston, South Carolina through cooperation with other institutions. On the main campus, lecture and laboratory space in the areas of geology, zoology, microbiology, and biochemistry are available for teaching and research in marine science.

Marine Resources Division of the South Carolina Wildlife and Marine Resources Department has 5,826 square feet of laboratory and office space. These facilities will be jointly used with educational institutions including library, auditorium, wet laboratory, storage, lounge and canteen, research laboratories, teaching laboratories, offices, boats and boat storage, and the R/V Dolphin owned and operated by this department. Clemson will utilize a lecture-laboratory room primarily in the summer. Research space for graduate students and staff are used on an irregular basis.

UNDERGRADUATE COURSES

Bot 446	Biological Oceanology	4
Geol 309/H309	Petrology	3
Geol 313	Stratigraphy and Sedimentation	3
Geol 403	Invertebrate Paleontology	3
Geol 405	Geomorphology	4
Geol 408	Geohydrology	3
Micro 403	Marine Microbiology	3
WB 460/H460	Biology of Marine Organisms	3
WB 462/H462	Aquatic Productivity	3
Zool 201	Invertebrate Zoology	4
Zool 202	Vertebrate Zoology	4
Zool 350/H350	Developmental Biology	4
Zool 403/H403	Protozoology	3
Zool 410/H410	Limnology	4
Zool 411/H411	Animal Ecology	4
Zool 412/H412	Aquatic Ecology	4
Zool 421	Advanced Invertebrate Zoology	4
Zool 463	Ichthyology	3
Zool 465	Ornithology	3

GRADUATE COURSES

Bot 646	Biological Oceanology	4
Geol 603	Invertebrate Paleontology	3
Geol 605	Geomorphology	4
Geol 608	Geohydrology	3
Geol 609	Petrology	3
Geol 613	Stratigraphy and Sedimentation	3
Geol 700	Earth Science I	3
Geol 750	Earth Science II	3
Micro 603	Marine Microbiology	3
WB 660	Biology of Marine Organisms	3
WB 662	Aquatic Productivity	3
WB 850	Marine Aquaculture	3
WB 852	Parasites and Diseases of Marine Animals	3
WB 856	Directed Studies and Fieldwork in Marine Biology	4
WB 891	Master's Research	TBA
Zool 603	Protozoology	3
Zool 610	Limnology	4
Zool 611	Animal Ecology	4
Zool 612	Aquatic Ecology	4
Zool 621	Advanced Invertebrate Zoology	4
Zool 663	Ichthyology	3
Zool 665	Ornithology	3

The instructional staff for the courses listed above consists of the following:

BIOCHEMISTRY

Shiveley, J.M., Ph.D., Professor and Department Head

BOTANY

Dillon, C.R., Ph.D., Associate Professor and Department Head

GEOLOGY

Birkhead, Paul K., Ph.D., Professor
Griffin, Villard S., Jr., Ph.D., Professor
Hatcher, Robert D., Jr., Ph.D., Assistant Professor
Snipes, David S., Ph.D., Associate Professor

MICROBIOLOGY

Baxter, Ann W., Ph.D., Associate Professor
Hayasaka, Steven S., Ph.D., Assistant Professor
Paynter, M.J.B., Ph.D., Professor and Department Head

ZOOLOGY

Ruppert, Mariette V., M.S., Instructor
Taylor, Robert J., Ph.D., Associate Professor
Wourms, John B., Ph.D., Associate Professor

WILDLIFE BIOLOGY

Fendley, Timothy T., Ph.D., Assistant Professor
Sweeney, John R., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. A.E. Schwartz, Dean
Graduate Studies and University Research
Clemson University
Clemson, South Carolina 29631

CLOVER PARK EDUCATION CENTER
Lakewood, Washington 98499

The Clover Park Education Center has focused on serving the commercial fishing industry of Washington by providing technical assistance and training to the people who man the nearly 10,000 fishing vessels licensed in the state.

The center provides training on a continuing education basis through courses and seminars concerning such topics as new laws and regulations, net mending, cable splicing, net construction, hydraulics, electronic equipment operation, and maintenance of depth sounding equipment such as Loran, radar, sonar, depth recorder, plus engine maintenance and operation. Emergency first aid, accounting and income tax is also included.

To obtain further information, address inquiries to:

Mr. Scott Harrington
Clover Park Education Center
4500 Steilacoom Boulevard Southwest
Tacoma, Washington 98499
(206) 584-7611

COLLEGE CENTER OF THE FINGER LAKES
Corning, New York 14830

Undergraduates are able to pursue studies and research in the marine sciences and the fresh water environment at two field sites operated by this consortium. One is the CCFL campus on San Salvador Island, the base for field projects in the Bahamas; the second is the Finger Lakes Institute at Seneca Lake near Watkins Glen, New York. On-campus scientific resources are available to undergraduates and faculty from the CCFL members -- Corning Community College, Elmira College and Hartwick College.

Courses in the Bahamas are open to undergraduates from other institutions, and faculty outside the consortium are invited to propose teaching-research projects. Colleges also contract to use campus facilities on San Salvador Island for their own field studies. An interdisciplinary curriculum is stressed, in which the marine sciences play a major role.

CCFL campus on San Salvador is based on a former U.S. naval installation at Graham's Harbour, at the invitation of the Bahamian government. Facilities include dormitories for 70 students, three classroom-laboratories, a wet lab housing a circulating sea water aquarium, faculty living quarters, a complete dining facility, and a library. Projects studying near-shore San Salvador waters are done aboard 18-foot outboards.

Credit for studies in the Bahamas is awarded by cooperating colleges or students may obtain credit from their home institutions. Tuition, room and board are paid to CCFL.

At the Finger Lakes Institute, studies are undertaken year-round on ice-free Seneca Lake. Academic year use is primarily for field work, and the summer for limnological field courses and courses in sailing. Field station facilities include a laboratory, dormitory for 20 people, 73-foot dock, and equipment room.

A listing of the degrees that the CCFL members award follows:

A.A.S., A.S. - Corning Community College
B.A., B.S., M.Ed., A.A.S. - Elmira College
B.A., B.S. - Hartwick College

The following courses are offered:

CORNING COMMUNITY COLLEGE

By	101	Botany	3
By	102	Zoology	3
By	003	General Biology	4
By	004	General Biology	4
By	201	Microbiology	4
By	203	Anatomy and Physiology	4
By	204	Anatomy and Physiology	4
By	210	Ecology	3
By	211	Field Biology	3
Ch	106	Introduction to Organic and Bio Chemistry	4
Ge	100	General Geology	3
Ge	103	Physical Geology	4
Ge	104	Historical Geology	4

ELMIRA COLLEGE

Bio	1110	Microbiology	4
Bio	2110	Comparative Anatomy	4
Bio	2020	Embryology	4
Bio	2040	Fresh Water Ecology	4
Bio	2070	Limnology I and II	4
Bio	3010	Invertebrate Zoology	4
Bio	3120	Ecology	4
Bio	4050	Microbiology II	4
Bio	4500	Independent Study	Variable
Env.	4090	Seminar - Environmental Science	1
Che	1510	Basic Chemical Principles I	4
Che	1511	Basic Chemical Principles II	4
Cec	3010	Computer Applications to the Natural Sciences	3-6
Geo	1010	Physical Geology	4
Geo	1020	Historical Geology	4

HARTWICK COLLEGE

Bio	213	Evolution	3
Bio	315	Ecology	4
Bio	316	Vertebrate Biology	4
Bio	320	Field Biology	6
Bio	450	Special Studies in Biology	4
Geo	311	Field Geology	4
Geo	450	Special Studies in Geology	4

SAN SALVADOR ISLAND CAMPUS, BAHAMAS (Credit awarded by cooperating colleges)

Marine Zoology	6
Ornithology	3
Entomology	3
Research and Caribbean Archeology	4
Astronomy	4
Geology of the Bahamas	4
Nearshore and Terrestrial Flora of San Salvador	4
San Salvador Winter Birds Study	4
Field Study in Geography	4

FINGER LAKES INSTITUTE - Summer Courses Offered
(CCFL colleges award undergraduate credit)

Basic Sailing - Theory and Practice	3
Basic Scuba	1.5

The instructional staff for the CCFL members consists of the following:

CORNING COMMUNITY COLLEGE

Anderson, Jack R., Ed.D., Professor of Geology
Chairman, Division of Biology and Chemistry
Brennan, John J., Professor of Biology
Brodkin, Marc A., Assistant Professor of Biology
Kephart, Robert E., Associate Professor of Biology
McGrath, Thomas A., Professor of Biology
Muck, Gordon Jr., Professor of Biology
Nash, Edward M., Professor of Biology
Nyberg, Don C., Professor of Chemistry
Wills, John E., Professor of Biology

ELMIRA COLLEGE

Foster, Donald B., Ph.D., Associate Professor of Biology
Hynes, Ronald, B.S., Instructor of Basic Scuba
Johnson, Howard R., Th.D., Associate Professor of Religion
Krist, Devin, Ph.D., Assistant Professor of Chemistry
Lindsay, William G., Ph.D., Professor of Biology
Merrill, Gilbert, M.S., Assistant Professor of Biology
Meyer, Josiah, Ph.D., Assistant Professor of Mathematics
Potter, Louise F., Ph.D., Professor of Biology
Shabanowitz, Harry, Ph.D., Associate Professor of Mathematics
Stephens, Lawrence J., Ph.D., Associate Professor of Chemistry

HARTWICK COLLEGE

Elliot, Nancy, Ph.D., Assistant Professor of Biology
Hartley, Charles L., Ph.D., Assistant Professor of Physics
Lyster, Norman C., Ph.D., Associate Professor of Education, Chairman, Department of Education
Miller, J. Robert, Ph.D., Professor of Chemistry
Rose, Richard M., Ph.D., Assistant Professor of Anthropology
Smith, Robert R., Ph.D., Assistant Professor of Geology
Tellis-Nayak, Vivian, Ph.D., Associate Professor of Sociology, Chairman, Department of Sociology and Anthropology
Titus, Robert C., Ph.D., Assistant Professor of Geology

To obtain further information, address inquiries to:

Mrs. Evelyn W. Wood
Executive Director
College Center of the Finger Lakes
Houghton House, 22 West Third Street
Corning, New York 14830

COLUMBIA UNIVERSITY
THE LAMONT-DOHERTY GEOLOGICAL OBSERVATORY
Palisades, New York 10964

Graduate students in marine sciences at Columbia University normally enroll in the Department of Geological Sciences, those in marine biology enroll in the Department of Biological Sciences. Students follow a program of study based on the varied courses offered within these departments. The major research facilities for the marine sciences (along with an extensive oceanographic library and computer facilities) are located at the Lamont-Doherty Geological Observatory campus of Columbia University in Palisades, New York.

The Observatory is located in Rockland County, New York, on top of the cliffs of the Palisades sill overlooking the west bank of the Hudson River, about 15 miles north of New York City. The 150-acre estate on which it is located was originally the home of the famous botanist, John Torrey. In 1928, the property was acquired by financier Thomas W. Lamont. His country house today serves as a library for the Observatory. After Thomas Lamont's death, the estate was given to Columbia University, which designated it for use as a research center in the earth sciences in 1949. Since the Observatory grew out of the Department of Geology of Columbia University it has always maintained a strong bond with the Department. Most of the faculty members in the Department are members of the senior research staff at the Observatory, and about 85% of the Department's graduate students conduct research there. Many classes are also held at the Observatory, and the University provides a shuttle-bus service to and from the Morningside Campus.

Research activities at the Observatory have as their basic objective the study of the solid earth and its oceans. Disciplines of immediate relevance are geophysics, oceanography, geology, and geochemistry, but a thorough approach is based on the fundamentals of physics, chemistry, biology, and mathematics. Specialists in all these sciences are working on the Observatory staff. The major activities at the Observatory fall into the categories described below. A student usually specializes in one of them. This does not preclude the possibility of engaging in related activities not listed or in disciplines which cross the boundaries of several fields.

The degrees of B.A., M.A., M. Phil., and Ph.D. in the Geological Sciences are offered by Columbia University.

OBSERVATIONAL SEISMOLOGY

Lamont-Doherty conducts a large and vigorous research program in observational earthquake seismology and maintains six major networks of seismometers located in tectonically interesting regions of the world -- Alaska, Pakistan, the Caribbean, Tadjikistan and Kirgizia (USSR), and New York State. The Alaskan and Caribbean networks, together with data from the World-Wide Standard Seismograph Network (WWSSN), are used to monitor spatio-temporal changes in seismic activity along some of the major tectonic regions. Observatory scientists and researchers have also been involved in the development of new instruments, such as the recently completed long-period broad-band ocean-bottom seismometer, which can record seismic data for several weeks. A photographic and magnetic tape library of seismograms at Lamont-Doherty contains the world's most extensive collection of basic seismic data, including the original data of the seismograph station networks operated by the Observatory and the Dominion Observatory of Canada, microfilm copies of all data from the WWSSN, and the data from the major networks run by Lamont.

THEORETICAL SEISMOLOGY

Active work is in progress at Lamont in wave-propagation studies to understand the structure of the earth's interior. A general computer program using full-wave theory to construct synthetic seismograms has been developed. This and other methods for constructing synthetic seismograms can be used to study the structure of the earth's interior at different depths. Projects range from the highly theoretical to the chiefly experimental. Students are involved at all levels of research, and a large portion of the student's training in earthquake seismology comes from research activities and association with the Observatory staff.

MARINE GEOLOGY AND GEOPHYSICS

Marine geophysical investigation is carried out by the Observatory on board the research vessels Vema (202-foot, 734-ton, 3-masted schooner) and the Robert D. Conrad (208-foot, 1,370-ton Agor-3) throughout the world and often in conjunction with ships and scientists of other countries. Instruments have been developed for measuring the magnetic and gravitational fields, making precision soundings, sonic-reflection and sonic-refraction determinations of the nature of the materials beneath the ocean floor, photographing the bottom, measuring light scattering at all depths, determining the flow of heat through the ocean floor, and studying the propagation of sound in the ocean. Lamont-Doherty is also an active participant in the JOIDES/IPOD deep sea drilling program. Graduate students are expected to participate in scientific programs aboard the research vessels in preparation for thesis work and as a part of their general education.

Major areas of specialization in Marine Geology and Geophysics are: Marine Seismology; Gravity and Geodesy; Marine Magnetism; Marine Geothermal Studies; Sedimentology, Micropaleontology, and Paleoceanography; Ocean Basin Stratigraphy; and Near Bottom Processes.

GEOCHEMISTRY

The areas of concentration in Geochemistry are Geochemical Ocean Sections Study -- The GEOSECS Program; Hydrothermal Alteration of Oceanic Crust and Sediments; Trace Metals; Sediment Mixing; Experimental Limnology; The Dynamics of the Hudson Estuary and New York Bight; Hudson River Sedimentation and Chemistry; and the Ecology of Marine and Estuarine Plankton. Researchers and students study the chemical reactions/actions of the ocean and the effects of these actions on the environment. In conjunction with the physical oceanography and marine biology groups, work is being done on the effects of pollutants on coastal waters.

WORLD OCEAN CIRCULATION STUDIES

The physical oceanography group at Lamont-Doherty is primarily concerned with the circulation and mixing of the ocean waters. One of the more important aspects of this work deals with the heat and water flux between ocean and atmosphere, which has an influence on the atmosphere, climate, and ocean water mass renewal. Much of the Observatory's attention is focused on the ocean south of 30°S, which is often designated as the Southern Ocean.

PALEOCLIMATOLOGY

Although the focus of this research is on major glacial and interglacial climatic fluctuations during the last million years, studies of lesser magnitude fluctuations during the last ten thousand years are also being pursued, as well as broad climatic changes over the last one hundred million years. The nature of the subject requires the integration of many aspects of oceanography, meteorology, and geology.

ATMOSPHERIC AND SPACE SCIENCES

Studies in the atmospheric sciences include investigations of wave propagation in the atmosphere and interface phenomena among air, earth and water. Investigation of the upper atmosphere is being carried out by means of sound from natural and artificial sources including the Concorde supersonic airplane. The space science program is conducted in cooperation with the Institute for Space Studies (located near Columbia University), a theoretical research institute of the Goddard Space Flight Center, NASA.

PETROLOGY

An active research group is studying the characteristics and origins of a wide range of volcanic and plutonic igneous rocks. Techniques utilized include XRF and atomic absorption analysis for minor and trace elements, atomic absorption analysis for major elements, mass spectrometric analysis for rare earth elements, strontium and lead isotopes, electron microprobe, and x-ray diffraction analysis of mineral phases.

PALEOMAGNETIC STUDIES

Paleomagnetic studies range over the complete spectrum of research in this field. Research continues in the magnetic stratigraphy of the sediments of world ocean; this research has made and will continue to make a significant contribution toward understanding the history and development of the evolution and extinction of marine organisms and unraveling the climatic record of the earth during the past five million years.

POLAR STUDIES

The problems of marine geophysics and geology are being explored in the Arctic and Antarctic with techniques adapted from operations in other oceans. Certain aspects of the polar seas, such as their floating ice cover, their intense magnetic activity, and their importance in climatic changes make them of special interest to students of oceanography, geophysics, and paleoclimatology. A continuing investigation of the Arctic Ocean is being carried out by staff and graduate students on floating ice research stations.

STRATIGRAPHY AND STRUCTURAL GEOLOGY

Graduate students at Lamont-Doherty have an unusual opportunity to study the nature and origin of geologic structures. The backgrounds and interests of staff members facilitate attempts to understand the relations of mountain-building processes to ocean floor tectonics, and the origin of ancient mountain belts in terms of recent and current tectonic activity.

TECTONOPHYSICS

The study of tectonophysics has as its goal an understanding of the fundamental physical processes that govern the deformation of rock and the manifestation of those processes in the various deformations within the solid part of the earth. At Lamont-Doherty, the tectonophysics program is concerned largely with the deformational properties of the lithosphere of the earth.

The following basic courses in marine sciences are offered by the Department of Geological Sciences. The exact curriculum to be followed by each student depends on his field of specialization and is decided upon by the student and his advisor. Other relevant courses are offered in the Departments of Physics, Chemistry, Biological Sciences and in the School of Engineering and Applied Science.

UNDERGRADUATE COURSES

Geology V1021	Physical Geology	4
Geology V1022	Historical Geology	4
Geology V1031	Ocean Science	3
Geology V1032	Planetary Geology	3
Geology V1041	Man's Physical Environment	3
Geology W1042	Man's Mineral Resources	3
Geology V1051	Principles of Geology I	3
Geology V1052	Principles of Geology II	3
Geology W3000	Tutorial Study in Earth Sciences	1-8
Geology W3010	Field Geology	1-3
Biology-Geology W3092	Urban Ecology	3
Geology V3522	Exploration Geology and Mining Geophysics I	3
Geology V3902	Introduction to Geophysics	3

Summer Session

Geology S1021	General Geology I	4
Geology S1022	General Geology II	4
Geology S3070	Field Research	1-3

GRADUATE COURSES

(The 4000 courses are open to qualified undergraduates as well as graduate students.)

SOLID EARTH GEOPHYSICS AND PLANETARY SCIENCE

Geology W4415	Principles of Rock Deformation	3
Geology W4901	Paleomagnetism	3
Geology W4915	The Inner Solar System	3
Geology W4941	Principles of Geophysics	3
Geology W4942	Geophysical Methods	3
Geology W4945-W4946	Geophysical Theory I and II	3
Geology W4947	Plate Tectonics	3
Geology G6908	Analysis of Geophysical Data	3
Geology W6947	Geomagnetism	3
Geology W6948	Gravity and Geodesy	3
Geology W6949	Advanced Seismology I	3
Geology W8950	Advanced Seismology II	3
Geology G9455	Tectonophysics Seminar	1-2
Geology G9945	Seismology Seminar	2-4
Geology W9947	Marine Geophysics Seminar	2

OCEANS AND ATMOSPHERES

Geology W4008	Introduction to Atmospheric Science	3
Geology W4030	Climatic Change	3
Geology W4885	The Chemistry of Continental Waters and Air	3
Geology W4902	Remote Sensing in Biology	2
Geology W4927	Principles of Oceanography	3
Geology G6920	Dynamics of Climate	3
Geology W6924	Ocean Currents and Mixing	3
Geology G6930	Dynamics of Ocean Currents	3
Geology G9910	Seminar in Atmospheric Sciences	2
Geology W9931	Physical Oceanography Seminar	1-6

TERRESTRIAL AND MARINE GEOLOGY

Geology W4001-W4002	Advanced General Geology I and II	4
Geology W4009	Chemical Geology	4
Geology W4049	World Regional Geology	3
Geology W4053	Geology of the New York Region	1
Geology W4076	Geologic Mapping	2
Geology W4113	Introduction to Mineralogy I	3
Geology W4114	Introduction to Mineralogy II	3
Geology W4120	Advanced Mineralogy	3
Geology W4130	Thermochemical Mineralogy	3
Geology W4201	Principles of Sedimentation	3.5
Geology W4221	Principles of Stratigraphy	3
Geology W4222	Phanerozoic Mountain Belts of North America	4
Geology W4226	Continental Shelf Sedimentation	3
Geology W4231	Quaternary Stratigraphy	2
Geology W4327	Principles of Geomorphology	3
Geology W4411	Principles of Structural Geology	3
Geology W4501	Introduction to Economic Geology	3
Geology W4521	Exploration Geology and Mining Geophysics II	2
Geology W4661	Introduction to Paleontology	3
Geology W4701	Introduction to Igneous and Metamorphic Petrology	3
TK 5081	Coastal Oceanography (held at Teacher's College, Columbia)	3
Geology W4883	Principles of Geochemistry	3
Geology W4928	Submarine Geology	3
Geology W4948	The Ocean Floor	3
Geology G6038	Mapping and Applied Geomorphology	2
Geology G6671-G6672	Lab in Invertebrate Paleozoology	1-3
Geology G6681	Micropaleontology I: Principles and Foraminifera	2
Geology G6682	Micropaleontology II: Radiolaria, Diatoms, and Coccoliths	2
Geology G6702	Petrology of Metamorphic Rocks	3
Geology G6705-G6706	Petrology of Igneous Rocks	3
Geology G8010	Field Geology	1-3
Geology G8446	Advanced Structural Geology	3
Geology G8665	History of Fishes	4
Geology G8666	History of Amphibians and Reptiles	4
Geology G8667	History of Mammals	4
Geology W8884	Advanced Geochemistry I	3
Geology W8886	Advanced Geochemistry II	3
Geology G9293-G9294	Seminar in Stratigraphy	1-6
Geology G9295-G9296	Seminar in Sedimentology	1-6
Geology G9335-G9336	Seminar in Geomorphology	1-6
Geology W9450	Seminar in Structural Geology	1
Geology G9668	Seminar in Vertebrate Paleontology and Evolution	2

Geology G9671-G9672	Invertebrate Paleozoology Seminar	2
Geology G9701-G9702	Advanced Petrology Seminar	3
Geology G9802	Seminar in Geochemistry	1
Geology G9911	Seminar in Ocean Sediments	2
Geology G9928	Advanced Submarine Geology Seminar	3

Summer Session

Geology S4020	Field Geology	3
Geology G9001-G9002	Research in Geology	1-6
Geology S9070A	Field Research	1-12
Geology S9893A	Research in Geochemistry	1-6
Geology S9993A	Research in Marine Geophysics	1-6

PROFESSORIAL STAFF

Alsop, Leonard E., Ph.D., Computational Methods
Broehker, Wallace S., Ph.D., Environmental Chemistry
Dalziel, Ian W.D., Ph.D., Structural Geology
Ewing, John I., B.S., Marine Seismology
Fairbridge, Rhodes W., Ph.D., Geomorphology
Gordon, Arnold L., Ph.D., Physical Oceanography
Hayes, Dennis E., Ph.D., Marine Geophysics
Hays, James D., Ph.D., Deep-Sea Sediments
Hunkins, Kenneth L., Ph.D., Arctic Studies
Jastrow, Robert, Ph.D., Atmospheric Science
Kuo, John T.F., Ph.D., Mining
Langseth, Marcus G., Ph.D., Heat Flow
Nafe, John E., Ph.D., Marine Geophysics
Opdyke, Neil D., Ph.D., Paleomagnetism
Pitman, Walter C., III, Ph.D., Marine Geophysics
Richards, Paul G., Ph.D., Seismology
Sanders, John E., Ph.D., Sedimentation and Stratigraphy
Scholz, Christopher H., Ph.D., Tectonophysics
Schweickert, Richard A., Ph.D., Stratigraphy
Simpson, H. James, Ph.D., Environmental Chemistry
Stoffa, Paul L., Ph.D., Geology
Sykes, Lynn R., Ph.D., Seismology and Tectonics
Takahashi, Taro, Ph.D., Geology
Talwani, Manik, Ph.D., Marine Geophysics
Watts, Anthony, Ph.D., Geology
Weaver, J. Scott, Ph.D., Geology

The research staff also includes more than 30 visiting Senior Research Associates, and about 50 additional research scientists. Senior Research Associates affiliated with Lamont-Doherty Geological Observatory are listed below:

Be, Allan, Ph.D.
Biscaye, Pierre, Ph.D.
Bonatti, Enrico, Ph.D.
Bryan, George, Ph.D.
Burckle, Lloyd, Ph.D.
Donn, William, Ph.D.
Gerard, Robert, M.Sc.
Houtz, Robert, B.A.
Hunkins, Kenneth L., Ph.D.
Jacob, Klaus, Ph.D.
Katz, Eli, Ph.D.
Kolla, Venkatarathnam, Ph.D.
Kukla, George, Ph.D.
Kutschale, Henry, Ph.D.
Langseth, Marcus G., Ph.D.
Larson, Roger L., Ph.D.
Li, Yuan-Hiu, Ph.D.
Ludwig, William, Ph.D.
MaLone, Thomas C., Ph.D.
Ninkovich, Charles D., Ph.D.
Opdyke, Neil D., Ph.D.
Pitman, Walter C., Ph.D.
Rabinowitz, Phillip, Ph.D.
Ruddiman, William F., Ph.D.
Ryan, William, Ph.D.
Takahashi, Taro, Ph.D.
Watts, Anthony B., Ph.D.

To obtain further information, address inquiries to:

Professor Manik Talwani, Director
Lamont-Doherty Geological Observatory of
Columbia University
Palisades, New York 10964
(914) 359-2900

or,

Graduate School of Arts and Sciences
Office of Admissions and Financial Aid
106 Low Memorial Library
Columbia University
New York, New York 10027
(212) 280-3808

CORNELL UNIVERSITY
Ithaca, New York 14853

There are many disciplines and courses at Cornell University that can prepare students for both general understanding and careers in various areas of aquatic and marine studies. The programs encompass basic and applied studies in the College of Agriculture and Life Sciences, Arts and Sciences, Engineering, and Veterinary Medicine. Departments and Divisions offering work in aquatic studies include: Agronomy, Avian and Aquatic Animal Medicine, Biological Sciences, Entomology and Limnology, Food Science, Geological Sciences, Natural Resources, and Nutritional Sciences. Inter-departmental coordination is provided through several multidisciplinary programs including the Aquaculture Program, Aquatic Sciences, Environmental Studies Program, and the Center for Environmental Research.

Facilities on or adjacent to the main campus include fully equipped laboratories for studies in aquatic animal medicine, aquatic plants, fish biology, fishery sciences, limnology, phycology, aquatic entomology, ichthyology, aquatic microbiology, invertebrate zoology, fish nutrition, environmental engineering, sanitary engineering, hydraulics, eutrophication, and water pollution. Support facilities in the form of library holdings, computer facilities, radiobiology facilities, water quality analysis services, and disease diagnostic services are extensive and readily available. A fishway, fish collecting facility, and spawning channel on Cayuga Lake, operated by the New York State Department of Environmental Conservation are available for research studies. Research vessels, the J.G. Needham and the Maritime, plus several small vessels are available for studies on Cayuga Lake. Approximately 100 small ponds designed for research studies are located near campus. The Cornell area has large aquifers of ground water available, a Fishery Laboratory, including wet labs; a radiation laboratory; a larval fish building and ponds; and the Munz Laboratory on Cayuga Lake. The ichthyology collection at Langmuir Laboratory is an especially complete collection of freshwater fishes from the northeastern United States.

Cornell University, in cooperation with the Sea Education Association, State University of New York, and the University of New Hampshire, operates the Shoals Marine Laboratory on Appledore Island, the largest of the Isles of Shoals, located 10 miles offshore from Portsmouth, New Hampshire. Facilities include two teaching laboratories equipped with running sea water, a dormitory, and a commons building. The laboratory is served by the 100-foot ferry Viking Queen, the 45-foot research vessel, Jere A. Chase, the 35-foot research vessel, Wrack, the 20-foot diesel launch, Scomber, the 22-foot sloop, Minnow, and several smaller vessels. Summer courses are offered in marine science and in nautical science.

Also offered through the Shoals Marine Laboratory and the Sea Education Association is a semester-length sequence of courses designed to provide college undergraduates with a thorough academic, scientific and practical understanding of the sea. Repeated approximately every two months, the 12-week sequence is comprised of a shore component (six weeks at Woods Hole, Massachusetts) and a sea component (six weeks aboard the R/V Westward). While at Woods Hole, students receive instruction in marine and nautical science and study the relationship of man with the sea. Enrollment is open to men and women judged capable of benefitting from SEA Semester, and no specific prior training or study is required. (For course listings, see Biological Sciences: 366-369.)

A freshwater biological station, equipped for fisheries and limnological studies, is located at Shackelton Point on Oneida Lake. The laboratory has one and one-half miles of shoreline, 400 acres of land, fully-equipped laboratories, dormitories, and extensive field equipment including research vessels of various sizes up to 35 feet. The station provides a full-year research program and a summer teaching program in aquatic ecology.

Cornell University and the State University of New York are partners in the New York Sea Grant Institute, New York's Sea Grant College, and conduct a broad program of research and extension on coastal problems through the Institute.

The Tunison Laboratory of Fish Nutrition at Cortland, New York conducts studies on salmonid nutrition and related fish cultural problems. The Laboratory operates under a cooperative agreement between the U.S. Fish and Wildlife Service and Cornell University. The New York Cooperative Fishery Research Unit, located on campus at Ithaca, also operates under a cooperative agreement among the U.S. Fish and Wildlife Service, Cornell University, and the New York State Department of Environmental Conservation.

Educational programs at Cornell University emphasize maximum flexibility and freedom of choice for the student. Specific programs of study are developed by the student in consultation with his advisor, or Special Committee -- in the case of graduate students. General degree requirements are kept to a minimum in order to provide the desired flexibility. Individual departments and advisors may, however, develop suggested programs within their areas of specialization. Undergraduate students must complete 120 credits with at least a C- average, and generally maintain eight terms in residence. Marine or aquatic programs are generally developed with advisors in the Division of Biological Sciences or the Department of Natural Resources.

At the graduate level, major and minor thesis areas are available in the following programs: botany (phycology); ecology and evolutionary biology (aquatic ecology; limnology; marine biology; oceanography; community and ecosystem ecology; paleoecology; vertebrate zoology, including herpetology and ichthyology); entomology and limnology (limnology); food science (aquatic microbiology); microbiology (aquatic microbiology); natural resources (aquaculture, aquatic ecology, fishery management, fishery science); nutritional sciences (fish nutrition, fish technology); veterinary medicine (fish and shellfish pathology); biochemical engineering; environmental systems engineering; hydraulic-hydrology; and sanitary engineering. Two terms in residence are normally required for masters degree program and six terms in residence (previous graduate study may be counted) for doctoral programs.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE AND GRADUATE COURSES (either)

AGRICULTURAL ENGINEERING

271	Applied Hydraulics	3
321	Soil and Water Conservation	2
325	Introduction to Environmental Pollution	3
471	Soil and Water Engineering	3
678	Water Quality Models for Nonpoint Sources	3

AGRONOMY

321	Soil and Water Conservation	2
331	Aquatic Plant Management	3
410	Microbial Ecology	3

BIOLOGICAL SCIENCES

274	The Vertebrates	5
310	Invertebrate Zoology	4
315	Ecological Animal Physiology	4
317	Ecological Animal Physiology, Laboratory	1
360	General Ecology	3
363	Introduction to Marine Science	5
365	Underwater Research	1
366	SEA Introduction to Marine Science	3
367	SEA Man and the Sea	2
368	SEA Introduction to Nautical Science	3
369	SEA Marine Science Laboratory	4
370 (369)	SEA Nautical Science Laboratory	4
414	Vertebrate Morphology (also Verterinary Medicine 700)	3
461	Oceanography	3
462	Limnology, Lecture	3
464	Limnology, Laboratory	2

469	Undergraduate Research in Ecology, Systematics and Evolution	various
470	Undergraduate Ecology Seminar	4
472	Herpetology, Lecture	3
474	Herpetology, Laboratory	2
476	Biology of Fishes, Lecture	4
478	Biology of Fishes, Laboratory	1
479	Ichthyology	5

ENTOMOLOGY

471	Bionomics of Freshwater Invertebrates	3

CIVIL AND ENVIRONMENTAL ENGINEERING

B693	Environmental and Water Resources Systems Analysis Colloquim	1
B780	Environmental Control Workshop	1-3
B791	Environmental and Water Resources Systems Analysis Design Project	various
B791	Environmental and Water Resources Systems Analysis Research	various
B794	Special Topics in Environmental or Water Resources Systems Analysis	various
C301	Fluid Mechanics I	3
C302	Hydraulic Engineering	3
C609	Descriptive Hydrology	2
C615	Fluid Mechanics II	3
C618	Dynamic Oceanography	3
C620	Analytical Hydrology	3
C621	Flow in Porous Media and Ground Water	3
C622	Engineering Micrometeorology	3
C631	Coastal Engineering I	3
C633	Coastal Engineering II	3
C641	Fluid Mechanics of Ambient Water Quality Control	3
C643	Unsteady Hydraulics	3
C693	Hydraulic Seminar	1
C694	Special Topics in Hydraulics	various
C744	Experimental and Numerical Methods in Hydraulics and Hydrology	2
C792	Research in Hydraulics	-
E301	Environmental Quality Engineering	4
E604	Assimilation of Pollutants in Natural Waters	3
E610	Chemistry of Water and Wastewater	3
E633	Environmental Quality Management	3
E712	Water Chemistry Laboratory	1
E715	Chemical and Physical Phenomena and Processes	4
E716	Biological Phenomena and Processes	4
E791	Design Project in Sanitary Engineering	various

GEOLOGICAL SCIENCES

344	Geological Oceanography	3
424	Tectonics of Orogenic Zones; Modern and Ancient	3
483	Marine Tectonics	3

MICROBIOLOGY

412	Aquatic Microbiology	3

NATURAL RESOURCES

438	Fishery Resource Management	4
440	Fishery Science	3
442	Techniques in Fishery Science	2
443	Ecological Aspects of Water Resources Management	3
444	Aquaculture	3
494	Research in Fishery Science	-
605	Ecology and Management of Disturbed Aquatic Systems	3
601	Seminar on Selected Topics in Fishery Biology	1

VETERINARY MEDICINE

671	Diseases of Aquatic Animals	3

GRADUATE COURSES (graduate only)

AGRICULTURAL ECONOMICS

250	Introduction to Resource Economics	3
350	Resource Economics	3

BIOLOGICAL SCIENCES

665	Limnology Seminar	1
666	Marine Ecology	3
670	Graduate Seminar in Vertebrate Biology	1
760	Special Topics in Evolution and Ecology	1-3
768	Ecosystems	3

APPLIED AND ENGINEERING PHYSICS

601	Photosynthesis	2

CHEMICAL ENGINEERING

431	Analysis of Separation Techniques	3
647	Wastewater Engineering in Process Industries	3

CIVIL AND ENVIRONMENTAL ENGINEERING

E611	Aquatic Chemistry	3
E693	Environmental Quality Engineering Seminar	1

ENTOMOLOGY

672	Seminar in Aquatic Ecology	1
695	Environmental Biology	1-3

VETERINARY MEDICINE

771	Graduate Seminar in Diseases of Aquatic Animals	-
772	Advanced Work in Aquatic Animal Diseases	-

The faculty for the courses listed above includes the following:

AGRICULTURAL ECONOMICS

Allee, D.J., Ph.D., Professor of Resource Economics
Chapman, L.D., Ph.D., Assistant Professor of Agricultural Economics
Conklin, H.E., Professor of Agricultural Economics
Goodrich, D.C., Ph.D., Professor of Marketing
Kalter, R.J., Ph.D., Associate Professor of Resource Economics

AGRICULTURAL ENGINEERING

Black, R.D., Ph.D., Associate Professor of Agricultural Engineering
Haith, D.A., Professor of Agricultural Engineering
Jewell, W.J., Ph.D., Associate Professor of Environmental Engineering
Levine, G., Ph.D., Professor of Agricultural Engineering and Director, Water Resources and Marine Sciences Center
Loehr, R.C., Ph.D., Professor of Agricultural and Environmental Engineering and Director of Environmental Studies
Ludington, D.C., Ph.D., Associate Professor of Agricultural Engineering
Price, D.R., Ph.D., Associate Professor of Agricultural Engineering
Shepardson, E.S., M.S.A., Professor of Agricultural Engineering
Walter, M.F., Professor of Agricultural Engineering

AGRONOMY

Alexander, M., Professor of Agronomy
Allaway, W.H., Professor of Agronomy
Peverly, J.H., Ph.D., Assistant Professor of Eutrophication

BIOLOGICAL SCIENCES

Anderson, J.M., Ph.D., Professor of Zoology
Barlow, J.P., Ph.D., Associate Professor of Oceanography
Brothers, E., Ph.D., Assistant Professor of Ecology and Systematics
Brussard, P.F., Ph.D., Professor of Ecology and Systematics
Chabot, B.F., Professor of Botany
Evans, H.E., Professor of Biological Sciences
Feeny, P.P., Professor of Ecology
Hall, C.A.S., Professor of Biological Sciences
Heiser, J.B., Professor of Biological Sciences
Kingsbury, J.M., Ph.D., Professor of Botany and Director, Office of Marine Biology
Levin, S.A., Ph.D., Associate Professor of Ecology and Systematics
Likens, G.E., Ph.D., Professor of Ecology
Marks, P.L., Professor of Biological Sciences
McFarland, W.N., Ph.D., Professor of Zoology
Pough, F.H., Ph.D., Professor of Herpetology
Root, R.B., Professor of Biological Sciences
Whittaker, R.H., Ph.D., Professor of Biology

ENGINEERING

Bisogni, J.J., Ph.D., Assistant Professor of Civil and Environmental Engineering
Brutsaert, W.H., Ph.D., Professor of Civil and Environmental Engineering
Dworsky, L.B., M.A., Professor of Civil and Environmental Engineering
Gates, C.D., M.S., Professor of Civil and Environmental Engineering
Gossett, J.M., Professor of Environmental Engineering
Jirka, G.H., Professor of Environmental Engineering
Liggett, J.A., Professor of Environmental Engineering
Liu, P.L.F., Professor of Environmental Engineering
Lynn, W.R., Ph.D., Professor of Environmental Engineering

ENTOMOLOGY

Berg, C.O., Ph.D., Professor of Aquatic Entomology
Pimentel, D., Professor of Entomology

GEOLOGICAL SCIENCES

Bloom, A.L., Ph.D., Associate Professor of Geological Sciences
Cisne, J.L., Ph.D., Assistant Professor of Geological Sciences
Karig, D.E., Ph.D., Assistant Professor of Geological Sciences
Travers, W.B., Ph.D., Assistant Professor of Geological Sciences

MICROBIOLOGY

Dondero, N.C., Ph.D., Professor of Applied Microbiology

NATURAL RESOURCES

Everhart, W.H., Ph.D., Professor of Natural Resources, and Chairman, Department of Natural Resources
Forney, J.L., Ph.D., Senior Research Associate, Natural Resources
Nickum, J.G., Ph.D., Assistant Professor of Fishery Biology and Director, Aquaculture Program
Oglesby, R.T., Ph.D., Associate Professor of Aquatic Sciences
Schofield, C.L., Ph.D., Senior Research Associate, Fishery Biology
Webster, D.A., Ph.D., Professor of Fishery Biology
Youngs, W.D., Ph.D., Assistant Professor of Fishery Biology

NUTRITIONAL SCIENCES

Baker, R.C., Ph.D., Professor in Food Science
Kinsella, J.E., Ph.D., Associate Professor in Food Science
Nesheim, M.C., Ph.D., Professor in Nutrition
Rumsey, G.L., Ph.D., Assistant Professor in Nutrition and Director, Tunison Laboratory of Fish Nutrition
Scott, M.L., Ph.D., Professor in Animal Nutrition

STATISTICS AND BIOMETRY

Robson, D.S., Ph.D., Professor in Biological Statistics

VETERINARY MEDICINE

Boyer, C.I., Jr., V.M.D., Professor in Laboratory Animal Medicine
Evans, H.E., Ph.D., Professor in Veterinary Anatomy
Georgi, J.R., Ph.D., Professor in Veterinary Parasitology
Gillespie, J.H., V.M.D., Professor in Veterinary Microbiology
Hitchner, S.B., V.M.D., Professor in Avian and Aquatic Animal Medicine
Houpt, T.R., Ph.D., Professor in Veterinary Physiology
King, J.M., Ph.D., Associate Professor in Veterinary Pathology
Leibovitz, L., V.M.D., Associate Professor in Avian and Aquatic Animal Medicine
Timoney, J.F., Ph.D., Assistant Professor in Veterinary Bacteriology

To obtain further information, address inquiries to:

Charles D. Gates
Field Representative
Field of Water Resources
223 Hollister Hall
Cornell University
Ithaca, New York 14853

DOWLING COLLEGE
Oakdale, New York 11769

The Dowling College Marine Science Program is a multi-discipline program of studies in oceanography. A wide range of marine science courses is offered affording students flexibility in meeting career objectives and interests. Students are encouraged to combine liberal arts in their program of studies.

Dowling College is located on the south shore of Long Island, on the Connetquot River, with direct access to Great South Bay and the Atlantic Ocean. A great variety of marine environments comprising the coastal zone and adjacent continental margin are readily accessible for study and research. The physical facilities include nine laboratories, two walk-in cold rooms, electronics laboratory, and storage rooms. The R/V Dolphin, a diesel-powered, 40-foot vessel is equipped with U-frame and gallows, a winch with double capstans and double drum, recording echo sounder, two salinometers, oxygen meter, water sampling bottles, reversing thermometer current meters, a variety of bottom sediment and samplers, mid-water trawl net, bottom biology trawl, plankton nets with flow meters, Loran-A and Loran-C navigation instruments, radar, radio-telephone, scuba tanks and regulators, diving vests, and underwater photographic equipment. Small boats used for estuarine research include 23-foot and 21-foot fiberglass boats powered by 160 horsepower inboard-outboard engines. Both are equipped with davit and hand-powered winch, plus echo sounder. Two smaller boats are powered by outboard engines. Laboratory equipment includes autoanalyzer, atomic absorption spectrophotometer, infrared spectrophotometer gas chromatographs, specific ion meter, ro-tap sieve shaker, and pH meters. The Morton Pickman Environmental Research Station owned by Dowling College consists of 15 acres of mature salt marsh located nearby the College. The College has the use of three large tanks supplied with running salt water located a 15-minute drive from the College. Under development are a research laboratory located on an island in Long Island South, and a mariculture facility located in Oakdale.

The following degrees are offered:

1. B.A. in Biology with concentration in Marine Biology.

   a) Thirty-five credits in Biology

2. B.A. in Natural Sciences and Mathematics with concentration in Marine Sciences.

   a) Twenty-five credits in Marine Sciences
   b) Twenty-five credits in two other disciplines within the Natural Sciences and Mathematics Division.

(Note: A degree in Marine Studies is planned for the immediate future.)

UNDERGRADUATE COURSES

BIOLOGY

Bio	17	Field Biology	5
Bio	31	Biology of the Invertebrates	5
Bio	33	Plant Structure and Function	5
Bio	61	Biology of the Vertebrates	5
Bio	71	Ecology	5
Bio	140	Physiology	5
Bio	150	Genetics	5

CHEMISTRY

Chem	76	Instrumental Analysis	5

MARINE SCIENCE

MS	6	Our Oceanic Environment	3
MS	7	Sea Techniques	2
MS	10	Mariculture	3
MS	11	Research Diving	3
MS	21	Underwater Photography	3
MS	33	Underwater Archeology	3
MS	55	Marine Biology	5
MS	74	Chemical Oceanography	4
MS	87	Marine Botany	5
MS	106	Physical Oceanography	4
MS	110	Marine Ichthyology	5
MS	112	Marine Geology	4
MS	131	Coastal Oceanography	4
MS	181, 182	Marine Science Seminar	2
MS	191, 192	Special Problems	Arranged

NATURAL SCIENCE

NS	27, 28	Elements of Geology	10
NS	15	Man and the Ecological Crisis	3

The instructional staff for the courses listed above consists of the following:

Brown, Robert Z., Sc.D., Professor
Dow, Gary, B.A., Captain, Research Vessel
Fisher, Kurt, Ph.D., Assistant Professor
Fray, Charles T., B.S., Associate Professor
Kamran, Mervyn, Ph.D., Associate Professor
Moeller, Henry W., Ph.D., Associate Professor
Shafer, Stephen, Ph.D., Associate Professor
Spingola, Frank, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Professor Charles Fray, Director
Marine Sciences Program
Dowling College
Oakdale, New York 11769

DRAKE UNIVERSITY
Des Moines, Iowa 50311

The Science Division of the College of Liberal Arts, in cooperation with Southampton College (New York), offers three undergraduate degree programs in the marine sciences. These degree programs combine elements of existing biology, chemistry and earth science majors, offered at Drake, with marine science courses appropriate to those majors that are offered by Southampton College.

The principle teaching and research facilities, in the marine sciences, are located at Southampton College, Southampton, New York 11968. (Southampton College is a division of Long Island University.) The campus is located on the south shore of Long Island; vessels operated by the College's Marine Science Center have direct access to Shinnecock and Peconic Bays and the Atlantic Ocean. A complete description of facilities and equipment is given under the Southampton College entry.

The following degree programs are offered:*

1. B.A. in Marine Science/Biology

a) Related coursework taken at Drake:

Biology	29 credits
Chemistry	20 credits
Mathematics	8 credits
Physics	8 credits

b) Coursework taken at Southampton:

Biology and Marine Science	22 credits

2. B.A. in Marine Science/Chemistry

a) Related coursework taken at Drake:

Chemistry	34 credits
Biology	11 credits
Mathematics	12 credits
Physics	8 credits
Geology	4 credits

b) Coursework taken at Southampton:

Geology and Marine Science	22 credits

3. B.A. in Marine Science/Earth Science

a) Related coursework taken at Drake:

Geology and Geography	28 credits
Chemistry	12 credits
Physics	8 credits
Mathematics	4 credits

b) Coursework taken at Southampton:

Geology and Marine Science	22 credits

The following undergraduate marine science courses are offered by Southampton College. Courses appropriate to the biology, chemistry, or earth science programs are selected from the group of courses.

MARINE SCIENCE

MS	107	Meteorology	4
MS	111	Introduction to Marine Science	4
MS	309	Physical Oceanography	4
MS	310	Chemical Oceanography	4
MS	311	Primary Productivity	4
MS	322	Fisheries Biology	4
MS	338	Marine Geology	4
MS	341	Marine Ecology	4
MS	390-391	Marine Operation and Research (Summer only)	6

GEOLOGY

Geo	207	Coastal Processes	4
Geo	302	Geochemistry	4

The teaching staff for the above courses is:

BIOLOGY

Hehre, Edward J., Ph.D., Assistant Professor
Reisman, Howard, Ph.D., Associate Professor
Walker, John R., M.S., Associate Professor

CHEMISTRY

Siegel, Alvin, Ph.D., Professor

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* In every case, students will transfer to Southampton, typically for one semester and a summer session. It is expected that the transfer will usually occur for the spring semester of the junior year. Students return to Drake for the senior year.

GEOLOGY

Berkebile, C. Alan, Ph.D., Associate Professor
McCormich, C. Larry, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. Dennis O'Brien
Department of Geology
Drake University
Des Moines, Iowa 50311

DUKE UNIVERSITY
Durham, North Carolina 27706

The Duke University Marine Laboratory (DUML) at Beaufort, North Carolina, is an interdepartmental and interuniversity facility for training and research in the marine sciences. It is open throughout the year with an academic and technical staff in residence. It presently occupies 15 acres on the southern portion of Pivers Island near Beaufort; the U.S. Department of Commerce, NOAA, National Marine Fisheries Service, and the Center for Menhaden Research are located on the remainder of the island.

The physical plant consists of twenty-four buildings including five dormitories, a large dining hall, one residence, boathouse, storehouse for ship's gear, classroom laboratories, seven research buildings, and a maintenance complex. The research laboratories and five dormitories are heated, and three dormitories are air conditioned, thereby providing favorable conditions for year-round research.

The station operates a well-equipped 118-foot research vessel, the *Eastward*, for training and research in oceanography, a 67-foot, steel-hull trawler, the *John de Wolf*, for shelf research, a 55-foot trawler for inshore and sound investigations and a 39-foot cabin power boat for trawling and dredging in the shallower portions of the estuary. Also available are a number of small power boats and rowboats with outboard motors and collecting gear, including dredges, bottom grabs, water sampler, coring devices, salinometers and fluorometers. The DUML library receives 155 current periodicals and is complemented by the added holdings of the NOAA library and the library of the University of North Carolina Institute of Marine Sciences, located in Beaufort-Morehead City area. An auditorium provides seating for 280 people plus smaller conference rooms. A stack area and a reading room are available.

Separate degrees are not offered in the marine sciences, but a student may pursue work for the A.M. and Ph.D. degrees in biochemistry, botany, chemistry, physiology and zoology. For the A.M. degree in geology, coursework may be taken and a thesis written in marine geology or geological oceanography. A B.S. in geology is offered with a curriculum preparatory to advanced studies in oceanography.

In botany, the student's graduate program is planned to provide broad basic training in various fields of botany, plus intensive specialization in the field of the research problem. Graduate courses in the Department of Geology are designed to provice training in the field of sedimentary geology and micropaleontology. Areas of specialization in thesis research include continental shelf sedimentation, deep-sea sedimentation, micropaleontology of deep-sea sediments and carbonate sedimentation.

Required work for the A.M. degree in zoology ordinarily includes 12 units of advanced coursework in zoology, six units of coursework in a minor department and an additional six units of advanced work in a major or minor department or in other pertinent departments. Furthermore, an acceptable thesis is necessary for the fulfillment of the degree requirements.

Normally the degree program for the Ph.D. includes graduate courses in biochemistry, botany, phsiology, and zoology, courses in the minor subject, wide reading in science in general and in biology in particular, research and a dissertation based on original work. Minor work is also available in the same fields plus anatomy, chemistry, geology, physics and engineering.

A graduate student working for the Ph.D. degree usually takes coursework on the main Durham campus in that particular department during the academic year and then goes to the marine laboratory for more specialized courses during the summer. By the end of the second year, he or she is expected to have passed an oral preliminary examination in his department. Thereafter, the student is free to do thesis research without further course requirements on the Durham and/or the DUML campus.

Training in the marine sciences at Duke University and at the Duke University Marine Laboratory is at the senior-graduate level in the Departments of Botany, Geology and Zoology, with the exception of the undergraduate spring term in the marine sciences which accepts students who have completed the sophomore requirements. Students are free to elect courses in any of the science departments including those in the School of Medicine and Engineering. Research and courses exist in the School of Engineering in the areas of communication theory, stochastic information processing, decision theory, digital computer systems, ocean structures and coastal formations. The undergraduate spring term provides students at the junior or senior level to spend an entire spring term at the marine laboratory, taking two courses, one seminar and one independent research program supervised by one of the resident staff.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

104	Homo Sapiens and the Marine Environment
114L	Introduction to Biological Oceanography
147	Plant Ecology
150L	Physiology of Marine Animals
169	Ecological Oceanography
176L	Marine Invertebrate Zoology
192	Independent Study
215L	Phytoplankton
220L	Adaptations to Marine Environment
296S	Seminar

BIOCHEMISTRY

Senior Graduate

220L	Adaptations of Organisms to the Marine Environment
276	Comparative and Evolutionary Biochemistry

BOTANY

Senior Graduate

204L	Marine Microbiology
211	Marine Phycology
215L	Phytoplankton
216L	Photosynthetic Physiology of Marine Plants
218	Barrier Island Ecology
247L	Plant Ecology

GRADUATE

359	Research in Botany
360	Research in Botany

GEOLOGY

Senior Graduate

205	Geological Oceanography
250	Introduction to Marine Geophysics

PHYSIOLOGY

Senior Graduate

212	Membrane Physiology and Osmoregulation

ZOOLOGY

Senior Graduate

203L	Marine Ecology
214L	Biological Oceanography
250L	Physiological Ecology of Marine Animals
274L	Marine Invertebrate Zoology
278	Invertebrate Embryology

Graduate

353	Research in Zoology
354	Research in Zoology

The instructional staff for the courses listed above consists of the following:

BIOCHEMISTRY DEPARTMENT

Bonaventura, Celia, Ph.D., Assistant Medical Research Professor of Biochemistry
Bonaventura, Joseph, Ph.D., Assistant Medical Research Professor of Biochemistry
Sullivan, James B., III, Ph.D., Associate Professor

BOTANY DEPARTMENT

Barber, Richard T., Ph.D., Professor of Botany and Zoology, Marine Ecology
Billings, William D., Ph.D., James B. Duke Professor of Botany, Plant Ecology
Johnson, Terry W., Ph.D., Professor of Botany, Marine Mycology
Ramus, Joseph S., Ph.D., Assistant Professor of Botany
Searles, Richard B., Ph.D., Associate Professor of Botany, Marine Phycology
White, Richard A., Ph.D., Chairman and Professor of Botany
Wilbur, Robert L., Ph.D., Professor of Botany, Plant Systematics

GEOLOGY DEPARTMENT

Heron, Stephen D., Ph.D., Professor of Geology, Sedimentary Petrology
Lynts, George W., Ph.D., Associate Professor of Geology, Micropaleontology
Perkins, Ronald, Ph.D., Chairman and Professor of Geology, Sedimentology
Pilkey, Orrin H., Ph.D., Professor of Geology, Marine Geology
Rosendahl, Bruce R., Ph.D., Assistant Professor of Geology

PHYSIOLOGY DEPARTMENT

Gutknecht, John, Ph.D., Associate Professor

ZOOLOGY DEPARTMENT

Bailey, Joseph R., Ph.D., Professor of Zoology, Vertebrate and Systematic Zoology
Barber, Richard T., Ph.D., Professor of Botany and Zoology, Marine Ecology
Bookhout, Cazlyn G., Ph.D., Professor Emeritus of Zoology, Invertebrate Embryology and Zoology
Costlow, John D., Jr., Ph.D., Professor of Zoology and Director of Duke University Marine Laboratory, Invertebrate Embryology and Zoology
Fluke, Donald J., Ph.D., Professor of Zoology, Biophysics
Forward, Richard, Ph.D., Associate Professor of Zoology, Physiological Ecology
Gray, Irving E., Ph.D., Professor Emeritus of Zoology, (ret.), Ecology
Lingstone, Daniel A., Ph.D., Professor of Zoology, Limnology
Lundberg, John G., Ph.D., Associate Professor of Zoology, Vertebrate and Systematic Zoology
McClay, David R., Ph.D., Associate Professor of Zoology
Sutherland, John P., Ph.D., Associate Professor of Zoology, Marine Ecology
Wainwright, Stephen A., Ph.D., Chairman and Professor of Zoology, Invertebrate Zoology
Wilbur, Karl M., James B. Duke Professor of Zoology, Cellular Physiology

To obtain further information, address inquiries to:

Director
Duke University Marine Laboratory
Beaufort, North Carolina 28516

EAST CAROLINA UNIVERSITY
Greenville, North Carolina 27834

The Institute for Coastal and Marine Resources was established to facilitate the human and natural resources associated with the coastal and marine environment of North Carolina. The Institute has three broad but interrelated programs:

1. Basic and applied research
2. Multidisciplinary instruction
3. Public education and advisory service

It is intended that the Institute provide informed guidance and develop manpower needed for the development and management of human and natural resources in the coastal zone.

The multidisciplinary instructional program at East Carolina University is designed to broaden students' perspective and understanding of coastal and marine resources and processes beyond that normally provided within the student's own discipline. The instructional program provides an undergraduate minor in Coastal Marine Studies organized around a small core of multidisciplinary Institute courses (COAS) together with a larger assemblage of courses from other departments. No degrees specifically designated as marine science or oceanography are offered. Students, within their specific degree program may elect to minor in coastal marine studies or select COAS courses as electives.

Research facilities for faculty and students are available on the Greenville campus and at the Pamlico Laboratory situated on South Creek, an embayment of the Pamlico Estuary. Research vessels are available to carry out investigations in the estuaries and sounds as well as near shore locations. Small boats are also available. Research is centered on estuarine ecology with emphasis on water and sediment quality, fisheries biology and submerged aquatic macrophytes. Other research activities include water recreation, history of boat and ship building, underwater history and marine geography.

The following courses are offered in conjunction with the coastal marine studies program:

INSTITUTE FOR COASTAL AND MARINE RESOURCES

COAS 2125	Survey of the Coastal Marine Environment	3
COAS 2150	Introduction to Nautical Science	3
COAS 2150L	Nautical Science Laboratory	1
COAS 5000	Shipboard and Underwater Research Techniques	3
COAS 5001	Coastal Marine Resources Problem Analysis I	3
COAS 5002	Coastal Marine Resources Problem Analysis II	3
COAS 5025 a, b, c	Man and the Sea Seminar	3

DEPARTMENT OF BIOLOGY

BIOL 5750	Coastal Plain Ecosystems of North Carolina	3
BIOL 5350	Biological Processes and the Chemistry of Natural Waters	4
BIOL 5550	General Ichthyology	5

DEPARTMENT OF GEOGRAPHY

GEOG 3002	Coastal Geography	3
GEOG 3005	Geography of Environmental Resources	3
GEOG 5098	Hydrology and Water Resources	3

DEPARTMENT OF GEOLOGY

GEOL 3600	Oceanography	3
GEOL 5350	Marine Geology	3
GEOL 5300	Geology of Coastal Processes and Environments	3

DEPARTMENT OF HISTORY

HIST 5160	American Maritime and Underwater History	3

PARKS, RECREATION AND CONSERVATION PROGRAM

PRCA 5600	Trends and Problems in Avocational Coastal and Oceanic Programs	3

URBAN AND REGIONAL PLANNING PROGRAM

PLAN 5020	Coastal Zone Planning and Management	3

The instructional staff for the courses listed above include the following:

Baker, Simon, Ph.D., Associate Professor of Geography
Bellis, Vincent J., Ph.D., Professor of Biology
Bort, John, Ph.D., Assistant Professor of Sociology and Anthropology
Brinson, Mark M., Ph.D., Associate Professor of Biology
Fricke, Peter, Ph.D., Senior Scientist, Institute for Coastal and Marine Resources and Visiting Associate Professor, Department of Sociology and Anthropology
Maiolo, John R., Ph.D., Chairperson, Department of Sociology and Anthropology
O'Connor, Michael P., Ph.D., Professor of Geology
O'Rear, Charles W., Ph.D., Associate Professor of Biology
Phelps, David S., Ph.D., Professor of Anthropology
Queen, William H., Ph.D., Director, Institute for Coastal and Marine Resources and Professor, Department of Biology
Riggs, Stanley R., Ph.D., Professor of Geology
Ryan, Edward P., Ph.D., Professor of Biology
Steele, Ralph H., Re.D., Professor of Recreation
Stephenson, Richard A., Ph.D., Professor of Geography
Still, William N., Ph.D., Professor of History

To obtain further information, address inquiries to:

Dr. William H. Queen
Institute for Coastal and Marine Resources
East Carolina University
Greenville, North Carolina 27834

EASTERN KENTUCKY UNIVERSITY
Richmond, Kentucky 40475

Eastern Kentucky University, located near the Kentucky River and the Appalachian Mountains, provides the facilities to support a fisheries management degree in the Department of Biological Sciences.

The study facilities include: boats, analytical instrumentation, field gear, over 2,400 square feet of specific laboratory space, and land and water resources for undergraduate and graduate studies in the specialization. More specifically, the field gear and instrumentation includes: scuba gear, temperature control chambers, field pH meters, liquid scintillation counter, gas chromatography, field recorders and probes, conference microscopes, oxygen analyzers, photographic equipment, seining, collection and capture devices and a multitude of electronic equipment used for field experimentation.

The department has established land and water resources for study through memorandums of understanding with county, state and federal agencies. The faculty extends study to all parts of the state and in neighboring regions. Recently, the university has acquired a 1,600 acre tract to establish an interdepartmental environmental education center for research and field classroom activities. The faculty works periodically with various municipal, state and federal agencies in coordinated research projects.

The following degrees are offered:

1. B.S. in Fisheries Management

a) Biology	56-59 credits
b) Chemistry	17 credits
c) Mathematics	6 credits
d) Physics, Geology or additional Chemistry	8-10 credits

2. M.S. in Biological Sciences

Thesis degree with specialization in coursework related to fisheries and aquatic biology (includes six hours of thesis research).

a) Minimum of 30 semester hours credit
b) Six laboratory courses related to the specialization
c) One foreign language requirement or an option in statistics and a computer science
d) A written comprehensive examination
e) Defense of thesis research

UNDERGRADUATE COURSES

BIO 316	Ecology	4
BIO 335	Plant Systematics	3
BIO 341	Invertebrate Zoology	4
BIO 510	Quantitative Biology	3
BIO 524	Phycology	3
BIO 557	Ichthyology	3
BIO 558	Limnology	3
BIO 561	Fisheries Biology	4
BIO 562	Fisheries Management	4
BIO 598	Special Problems	1-3

GRADUATE COURSES

BIO 601	Scientific Literature	2
BIO 602	Select Topics in Biological Sciences, i.e., Aquatic Arthropods and Aquatic Plants	3-6
BIO 616	Biogeography	3
BIO 645	Vertebrate Physiological Ecology	3
BIO 647	Advanced Animal Ecology	3
BIO 691	Thesis Research	6

(NOTE: BIO 500 level - under limitations, courses in Ichthyology, Fisheries Biology, Fisheries Management, Limnology, Phycology, Parasitology and Quantitative Biology may be assigned as graduate credit, as well as advanced courses in the supporting sciences.)

The faculty of the departments that teach in courses related directly to the specialization are:

Batch, Donald L., Ph.D., Professor
Branson, Branley, Ph.D., Professor
Creek, Robert O., Ph.D., Associate Professor
Cupp, Paul V., Ph.D., Assistant Professor
Harley, John P., Ph.D., Associate Professor
Lassetter, J. Stuart, Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. Edwin A. Hess, Chairman
Department of Biological Sciences
Eastern Kentucky University
Richmond, Kentucky 40475
(606) 622-2212

THE EVERGREEN STATE COLLEGE
Olympia, Washington 98505

The Evergreen State College campus has 3,000 feet of waterfront on Eld Inlet, an arm of Puget Sound. For marine studies, the main laboratory building and a residence converted to a field facility on the waterfront are used. Another facility adjacent to the Nisqually National Wildlife Refuge serves as a field station and interpretive center for marine and terrestrial field studies. The main laboratory building is well equipped for chemical analyses including capability for trace organic substances and trace metals. There is variety of marine field sampling gear and field instruments for water quality measurements. The College has five small boats ranging from a 14-foot to a 17-foot Boston Whaler, all with outboard engines. A 38-foot research vessel, a sailing cutter with auxiliary engine, is under construction on campus and scheduled for completion in 1979 or early 1980. Two 44-foot yawls are being reconditioned for use in marine programs in future years.

Bachelor of Arts and Bachelor of Science (beginning in 1979-1980) degrees are offered. Evergreen's curriculum emphasizes full-time team-taught multidisciplinary or theme-oriented programs of studies more than single-subject part-time courses. The specific programs offered vary each year. Two areas of specialization incorporate marine subjects: "Marine Studies" and "Environmental Studies."

Only courses available in 1979-1980 are listed below. The curriculum for 1980-1981 will be announced during the Fall quarter 1979, and it will be expanded relative to 1979-1980. It will incorporate more social science and humanities, and a principal theme will be marine and maritime "exploration." A graduate program will begin at the College for 1980-1981 but not including marine studies initially.

UNDERGRADUATE COURSES (1979-1980 - Quarter System)

MARINE BIOLOGY Fall 1979 - 16 credits
(A survey of marine organisms and marine ecology.)

TROPICAL REEF ECOLOGY Winter 1980 - 16 credits
(Coral reef ecology, based in Hawaii.)

FISHES AND FISHING IN PUGET SOUND
Spring 1980 - 16 credits
(Ecology of fishes and marine fisheries of Puget Sound.)

The instructional staff for the courses listed above include the following:

- Cook, Sherburn S., Jr., Ph.D., Biology
- Eickstaedt, Larry L., Ph.D., Biology
- Filmer, Robert W., Ph.D., Applied Science and Technology
- Kuehn, Lowell, Ph.D., Sociology
- Ladd, Kaye V., Ph.D., Inorganic Chemistry
- Milne, David H., Ph.D., Biology
- Sinclair, Leon R., Ph.D., Literature
- Skov, Neile A., Ph.D., Oceanography
- Sluss, Robert R., Ph.D., Biology
- Stroh, James, Ph.D., Geology
- Taylor, Peter B., Ph.D., Oceanography

To obtain further information, address inquiries to:

Dr. Larry L. Eickstaedt
The Evergreen State College
Olympia, Washington 98505
(206) 866-6312

FAIRLEIGH DICKINSON UNIVERSTIY
Madison, New Jersey 07940

WEST INDIES LABORATORY
of
FAIRLEIGH DICKINSON UNIVERSTIY
Christiansted, St. Croix
U.S. Virgin Islands 00820

The West Indies Laboratory is a tropical teaching and research facility of Fairleigh Dickinson University of New Jersey. It is not a degree granting part of the University although it provides support for degree programs offered in marine biology and earth sciences options in marine geology. Courses are offered at both undergraduate and graduate levels throughout the year and college credit may be transferred to other Universities.

The Laboratory occupies an eight-acre tract facing coral reef-bordered Tague Bay and Buck Island Reef National Monument. The present Laboratory consists of 12 building, including a four-wing dormitory, a dining hall, a machine shop, a library, four staff residences, dock-site dive locker and research labs, and a classroom and research laboratory building. A tertiary sewage treatment plant and auxiliary power plant are also on the site.

Although it is a teaching laboratory, it also serves as a center for tropical environmental research. Under contract with the federal government, the West Indies Laboratory operates the United States'only functional underwater habitat. The OCEANLAB project is committed to the exploration and harnessing of the ocean's resources for the future good of mankind. The Faile Marine Science Center, an estate recently donated to the University, supports the research efforts of the West Indies Laboratory. It serves as a backup for the underwater habitat and as the site of educational conferences in marine science and other academic endeavors.

St. Croix is the largest of the U.S. Virgin Islands (85 square miles) and is readily reached by several major airlines with many daily direct jet flights from New York, Washington, D.C. and Miami. San Juan, Puerto Rico is only 45 minutes away by air and frequent daily flights are available.

The Laboratory operates under its own director and maintains a permanent resident staff including two marine biologists, a marine geologist, and various technical and maintenance personnel. The Lab is open during the entire year. It offers formal courses of instruction during the Summer, Fall, January and Spring periods. It also provides year-round facilities for graduate and undergraduate students and visiting investigators who wish to take advantage of specific St. Croix environments for research and special project work. University Affiliate and Visiting Group Programs are also available.

A wide variety of basic biologic and geologic laboratory and field equipment is available for use. Running sea water is pumped directly from the ocean to the Lab. Scuba facilities, eight boats and four field vehicles are maintained for scientific use. Numerous intertidal, lagoonal/shelf and shelf edge environments are readily available for study. NAUI certification is available for student and faculty wishing to develop scuba proficiency.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

WI 201	Project Planning and Proposal Writing	2
WI 203	Introduction to Marine Science	6
WI 205	Advanced Diving for Scientific Studies	2
WI 349	Biology of Tropical Marine Invertebrates	4
WI 354	Marine Ecology	6
WI 355	Tropical Marine Geology, Processes and Organisms	4
WI 400	Special Problems	1-6

GRADUATE COURSES

WI 501	Tropical Field Botany	3
WI 505	Problems in Tropical Marine Biology	3
WI 552	Biology of Marine Algae	6
WI 554	Ecology of Coral Reefs	6
WI 555	Marine Geology	6
WI 557	Problems in Marine Geology and Carbonate Environment	3
WI 850	Special Problems	1-6

The instructional staff for the courses listed above consist of the following:

LABORATORY RESIDENT FACULTY

Dill, Robert F., Ph.D., Director, Professor (Marine Geology)
Gladfelter, William, Ph.D., Assistant Professor (Marine Invertebrates)
Hubbard, Dennis, Ph.D., Assistant Research Scientist
McGowan, Steven, B.S., Biology (Laboratory techniques)
Ogden, John C., Ph.D., Associate Professor (Marine Ecology)
Ogden, Nancy, M.S., Teaching Assistant (Phycologist)
Suchanek, Thomas, Ph.D. (Biology)
Tonnemacher, Henry, B.S., Diving Supervisor

VISITING FACULTY

Abel, Robert B., NOAA, Sea Grant Program (Chemical Oceanography)
Adey, Walter H., Smithsonian Institution (Crustose coralline algae)
Fosberg, Raymond, Smithsonian Institution (Terrestrial Botany Systematics)

To obtain further information, address inquiries to:

Dr. Robert F. Dill
Office of the Director
West Indies Laboratory
P.O. Box 4010, Christiansted
St. Croix, U.S.V.I. 00820
(809) 773-3339

or,

Dr. John E. Lynch, Coordinator
West Indies Lab Information Office
Fairleigh Dickinson University
Rutherford, New Jersey 07070
(201) 933-5000, ext. 426

(NOTE: All Visiting Faculty have their Ph.D. Degrees.)

FLORIDA ATLANTIC UNIVERSITY

Boca Raton, Florida 33431

Florida Atlantic University offers ocean engineering and marine science courses at its main campus in Boca Raton, Florida. Florida Atlantic University is an upper division university (junior and senior years plus graduate work) which includes Colleges of Science and Engineering. It is a part of the State of Florida University System. Students entering FAU must have successfully completed two years at a junior college or the equivalent at a four year institution and meet the prerequisites of the department they desire to enter. Courses in the marine sciences are offered during the academic year by the departments of Biological Sciences, Geography, Geology and Ocean Engineering. Both Biological Sciences and Ocean Engineering offer regular summer and special workshop courses on the Boca Raton campus.

DEPARTMENT OF OCEAN ENGINEERING

Florida Atlantic University offers Bachelors and Masters degrees in a Department of Ocean Engineering. The University is located in Boca Raton on the southeast coast of the Florida peninsula and the Department's facilities are two miles from shore and two and one-half miles from the Florida Current (Gulf Stream). The 33-foot research vessel, Oceaneer IV, is operated along with numerous small crafts. Special laboratory facilities include: scanning electron microscope, wave tanks, specialized computer facilities for acoustic data analysis, anechoic chambers -- wet and dry, compression tanks for depth simulation, sub-bottom acoustic profiler, side scan sonar, magnetometers, sediment analysis equipment, computer terminals with graphics capabilities, complete laboratories for metallurgy, fluid mechanics, vibrations, and ocean structural experiments. A complete dive locker with diver propulsion, wet submarines, and wireless communication equipment is maintained.

The Department of Ocean Engineering provides a comprehensive, practical curriculum in science and engineering which will prepare the student to perform engineering tasks in the ocean environment. Graduates of this program are prepared for graduate studies in Ocean Engineering and for professional positions in industry and government.

This program requires a firm foundation in English composition and grammar, mathematics, chemistry and physics at the lower division level, plus courses in the social sciences and humanities for a balanced educational background for the engineering profession. These are provided in the pre-engineering or pre-ocean engineering (university parallel) programs of junior colleges and the lower division pre-engineering programs of most four year colleges.

The Ocean Engineering program includes integrated courses encompassing basic engineering sciences and mathematics; study of the ocean environment and its relationship to other sciences and engineering; processing of ocean engineering data; and the application of these elements to the solution of engineering problems connected with work in or on the ocean and in developing the resources of the oceans.

Emphasis is placed on the solution of problems related to working in the ocean in such areas as underwater acoustics, fluid mechanics, structures, electronics, and materials. An optional Cooperative Work-study program is offered which provides practical experience in industry or government laboratories to students who can qualify.

The Ocean Engineering Program at FAU was designated a "State University System Program of Distinction" by the Board of Regents in October 1974. The designation was one of the five originally made throughout the entire State University System.

The following degrees are offered:

1. M.S. in Ocean Engineering. The Department of Ocean Engineering offers programs of graduate study leading to a master's degree in Ocean Engineering. A thesis option requires a minimum of 45 credits of work, including a thesis, and leads to a Master of Science in Engineering degree. The non-thesis option requires a minimum of 54 credits of work and leads to a Master of Engineering degree.

Students who wish to specialize may pursue in-depth studies in the areas of marine materials and corrosion, underwater communication and acoustics, ocean structures, and hydrodynamics.

At least one-half of all graduate work must be 6000 level courses. The balance may be either undergraduate, 5000 or 6000 level as approved by the student's advisory committee. Students who enter the graduate program from undergraduate curricula which do not provide an engineering background or adequate preparation for required graduate courses will be expected to complete additional undergraduate courses for which no graduate credit may be received.

During the academic year 1978-1979, 43 B.S. degrees were awarded, five Masters of Science, and two Masters of Engineering.

2. B.S. in Ocean Engineering. The Department of Ocean Engineering provides a comprehensive, practical undergraduate curriculum in science and engineering which will prepare the student to perform engineering work in the ocean. Graduates of this program are prepared for graduate studies in Ocean Engineering and professional positions in industry and government.

As Florida Atlantic University is an upper division university, it admits students at the junior year level. The program requires a firm foundation in English composition and grammar, mathematics, chemistry and physics at the lower division level, plus courses in the social sciences and humanities for a balanced educational background for the engineering profession. These are provided in the pre-engineering or pre-ocean engineering (university parallel) programs of junior colleges and the lower division pre-engineering programs of most four-year colleges.

The curricula leading to the baccalaureate degree in Ocean Engineering, both regular and cooperative programs, are accredited by the Engineers' Council for Professional Development (ECPD).

The following courses are offered in conjunction with the above programs (credits are in quarter hours):

DEPARTMENT OF OCEAN ENGINEERING

UNDERGRADUATE COURSES

EOC 3000	Introduction to Ocean Engineering	3
EOC 3001	Engineering Algorithms	10
EOC 3113	Statics and Particle Dynamics	5
EOC 3114	Dynamics and Vibrations	5
EOC 3123	Fluid Mechanics for Ocean Engineering	5
EOC 3141	Engineering Thermodynamics I	3
EOC 3143	Engineering Thermodynamics II	3
EOC 3150	Strength of Materials	5
EOC 3200	Engineering Materials I	3
EOC 3306	Acoustics	4-5
EOC 3800	Ocean Engineering Design	3
EOC 4115	Vibration, Shock and Noise Control	4
EOC 4130L	Experimental Ocean Engineering	3
EOC 4193	Heat Transfer	3
EOC 4201	Engineering Materials II	3
EOC 4204	Marine Materials and Corrosion	4
EOC 4308	Underwater Sound Propagation	4
EOC 4410	Ocean Structures	4
EOC 4414	Ocean Structural Design	4
EOC 4503	Hydrodynamics of Ocean Systems	4
EOC 4631	Acoustic Signal Processing	4
EOC 4804	Ocean Engineering System Design	3
ECO 4804L	Ocean Engineering Design Project	3
EOC 4905	Directed Independent Study	1-5
EOC 4930	Special Topics	1-5
EOC 4949	Cooperative Education-Ocean Engineering I and II	1-4
OCC 3002	Chemical Oceanography	3
OCE 3001	Introduction to Oceanography (Pass-fail option available)	4
OCG 3001	Geological Oceanography	3
OCP 4005	Physical Oceanography	3

GRADUATE COURSES

EOC 5220	Soil Mechanics for Ocean Engineers	3
EOC 6135L	Ocean Engineering Laboratory	3
EOC 6152	Advanced Mechanics of Materials in Ocean Applications	3
EOC 6153	Theory of Plates	3
EOC 6154	Theory of Elasticity	3
EOC 6155	Finite Element Method for Ocean Structures	3
EOC 6180	Modern Hydrodynamics	3
EOC 6181	Ocean Hydrodynamics	3
EOC 6185	Hydrodynamics of Ideal Flow	3
EOC 6186	Hydrodynamics of Viscous Flow	3
EOC 6187	Advanced Marine Hydrodynamics	3
EOC 6194	Advanced Heat Transfer	3
EOC 6195	Mass Transfer	3
EOC 6216	Corrosion I	3
EOC 6218	Corrosion II	3
EOC 6225	Sediment Properties and Near Shore Processes	3
EOC 6310	Underwater Acoustics	3
EOC 6311	Advanced Acoustics I	3
EOC 6312	Advanced Acoustic II	3
EOC 6405L	Experimental Stress Analysis	3
EOC 6415	Ocean Structures Analysis	3
EOC 6425	Ocean Structural Dynamics	3
EOC 6615	Linear Systems Analysis	3
EOC 6630	Signal Processing	3
EOC 6908	Directed Independent Study	1-5
EOC 6934	Special Topics	1-6
OCE 6066	Physical Aspects of Oceanography	3
OCE 6971	Master's Thesis	1-15

The instructional staff for the program as described consists of the following individuals:

DEPARTMENT OF OCEAN ENGINEERING

Czarnecki, M.F., Ph.D., Assistant Professor
Davidson, J.B., M.S., Professor
Dunn, S.E., Ph.D., P.E., Professor
Hartt, W.H., Ph.D., P.E., Professor
Martin, P.E., M.S., P.E., Instructor
McAllister, R.F., Ph.D., Professor
Stevens, K.K., Ph.D., P.E., Professor
Su, C. L., Ph.D., P.E., Associate Professor
Tennant, J.S., Ph.D., P.E., Professor and Chairman
Tessin, W., Ph.D., P.E., Professor
Wolf, D.S., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. J.S. Tennant, Professor and Chairman
Department of Ocean Engineering
Florida Atlantic University
Boca Raton, Florida 33431

DEPARTMENT OF BIOLOGICAL SCIENCE

The Department of Biological Sciences of Florida Atlantic University, an upper-division State university, has its research and teaching facilities on the main campus in Boca Raton. The facilities are housed in the modern five-story Biological Sciences building located approximately two miles from the Florida Straits of the Atlantic Ocean, where the Gulf Stream reaches its closest point to the U.S. mainland. Research facilities for botany, ecology, ichthyology, and invertebrate zoology are located on the upper three floors of the building while laboratories for microbiology and cell biology are centered on the second floor. Facilities for transmission and scanning electron microscopy are on the first floor. Construction of an oceanside teaching and research laboratory in Boca Raton is anticipated for the near future.

The following degrees are offered:

1. B.S. in Biological Sciences with emphasis in Marine Biology.

a) Completion of a core curriculum of approximately 40 quarter credit hours including cell biology, Mendelian genetics, microbiology, organic chemistry, bio-organic chemistry, biochemistry, biophysical chemistry, and statistics.

b) Completion of the required emphasis courses:

OCE 3001	Introduction to Oceanography	4
PCB 4043	Principles of Ecology	4
BOT 4404C	Survey of the Algae	4
BOT 4343C	Thallophytes	5
ZOO 4203C	Invertebrate Zoology I	4
ZOO 4204C	Invertebrate Zoology II	4
ZOO 4323C	Comp. Vertebrate Morphogenesis	4
PCB 4723C	Comp. Animal Physiology I	4
PCB 4724C	Comp. Animal Physiology II	4
OCB 4043C	Marine Biology	4

c) Completion of a reading skills course in a modern foreign language.
d) Completion of a minimum of 18 out-of-college quarter credits.
e) Completion of free electives for a minimum of 90 upper-division quarter credits.

2. M.S. in Biological Sciences with emphasis in Marine Biology.

a) A minimum of 45 quarter credits including nine for Thesis research.
b) Presentation of three graduate seminars.
c) Presentation of a Master's Thesis.
d) Reading skills in French, German, or Spanish.
e) A written comprehensive examination.

The following courses are offered in conjunction with the M.S. program:

BCH 6506C	Enzymology	5
BOT 6406C	Algology	5
BOT 6409	Studies in Algology	3
BOT 6665C	Topics in Tropical Botany	1-5
BSC 5005	Seminar in Biological Writing	2
BSC 5931	Special Topics	1-5
BSC 6907	Directed Independent Study	1-5
BSC 6932	Seminar	1
BSC 6971	Master's Thesis	1-9
MCB 6407C	Bacterial Physiology	5
MCB 6736	Microbial Physiology in the Sea	3
MCB 6806C	General Mycology	4
OCB 4043C	Marine Biology	4
PCB 5175C	Microtechnique	5
PCB 6256	Developmental Biology	3
PCB 6307C	Freshwater Ecology	5
PCB 6317C	Marine Ecology	5
PCB 6346C	Experimental Ecology	3
PCB 6406	Ecological Theory	4
PCB 6457C	Biosystematics	5
STA 5176	Applied Biometrics	5
ZOO 6256C	Marine Invertebrate Zoology I	4
ZOO 6457C	Marine Invertebrate Zoology II	4
ZOO 6456C	Natural History of Fishes	5
ZOO 6459	Seminar in Ichthyology	1-2
ZOO 6516C	Neuroethology	4

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGICAL SCIENCES

Adams, Ralph M., Ph.D., Professor
Austin, Daniel F., Ph.D., Professor
Boss, Manley L., Ph.D., Professor
Courtenay, Walter R., Jr., Ph.D., Professor
Dobkin, Sheldon, Ph.D., Professor
Iverson, Ray M., Ph.D., Professor
Sguros, Peter L., Ph.D., Professor
Sturrock, Thomas T., Ph.D., Professor

Associate Professors:

Grimm, Robert B., Ph.D.
Marsh, G. Alex, Ph.D.

To obtain further information, address inquiries to:

Dr. Sheldon Dobkin, Chairman
Department of Biological Sciences
Florida Atlantic University
Boca Raton, Florida 33431
(305) 395-5100, ext. 2706

FLORIDA INSTITUTE OF TECHNOLOGY

Melbourne, Florida 32901

The Oceanography programs combine classroom and laboratory work, at the main campus in Melbourne, with the analysis of oceanographic data collected by students using departmental research vessels and boats.

Much of the instructional work on estuarine and coastal waters is conducted as part of applied research contracts utilizing the department's small motor powered skiffs and a twin-diesel powered research boat (42-feet). Offshore work is done from larger ships (42-feet to over 65-feet) owned and operated by F.I.T. These ships, located at F.I.T.'s Link Port base near Fort Pierce to the south, provide the student with access, through the Fort Pierce Inlet, to the Gulf Stream in about two hours. This route to the sea also supplies convenient access to the Bahamas and the Florida Keys. Ship operations are also conducted, using the department's 65-foot R/V Sea Hunter, out of Port Canaveral to the north. The larger ships are equipped for overnight operations and are fitted with appropriate instrumentation.

Six laboratories (Biological Oceanography, Chemical Oceanography, Geological Oceanography, Physical Oceanography, Ocean Structures and Marine Corrosion) are located at the main campus in Melbourne.

UNDERGRADUATE DEGREES

During the first two years the oceanography student concentrates on building a strong foundation in mathematics, physics, chemistry, biology, and humanities. The student may choose one of four options: Physical, Chemical, Biological, or Geological oceanography. Transferring from one option to another during the first two years will incur little loss of academic credit. In all options, emphasis has been placed on a broad scientific background for the student so that he is prepared for more advanced studies in graduate school or employment by industry or government. The department promotes the concept of applied research through a strongly recommended summer shipboard program (Marine Field Projects) or a senior academic year research program (Senior Project). Both programs are conducted under the direction of faculty members and are designed to help the student utilize previous academic course work in a relevant manner. The Bachelor of Science degree conferred through the Department of Oceanography and Ocean Engineering on the Melbourne campus is designed to prepare students to work as professional scientists and enables the individual to pursue graduate studies. Non-departmental Technician-technology oriented marine programs are offered in the School of Applied Technology on the Jensen Beach Campus for those students not pursuing a professional science oriented curriculum.

The Ocean Engineering curriculum is designed to explore the engineering implications of man's relationship to the oceans. The first two years of study are devoted to giving the student a scientific foundation in mathematics, physics, chemistry, mechanics, and humanities. In the junior year the student will gain a knowledge of oceanographic parameters and the basics of engineering analysis. The fourth year is oriented towards the application of these basics to accomplish work in the oceans. The program requires a student to participate in an ocean engineering project. The student may schedule this requirement during the summer between the junior and senior year in the Marine Field Projects program or if necessary a limited number of students may conduct a project during the senior academic year. These student projects encourage the analysis, design, construction, installation, and operation of equipment in the ocean to a designated task.

GRADUATE DEGREES

The degree of Master of Science in Oceanography or in Ocean Engineering may be conferred upon students who have successfully completed a minimum of forty-eight quarter hours (including thesis) of required and elective work. Applicants seeking admission to one of the programs should have a Bachelor's degree in the related sciences from an institution acceptable to the Graduate School. The programs offered are:

Bio-Environmental Oceanography
Chemical Oceanography
Geological Oceanography
Physical Oceanography
Ocean Engineering
Coastal Zone Management

Degrees granted:

M.S. in Oceanography	(8)
M.S. in Ocean Engineering	(1)
B.S. in Oceanography	(28)
B.S. in Ocean Engineering	(25)

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

O	1101	Oceanology Concepts	2
O	2101	Introduction to Oceanography	3
O	2601	General Geology	3
O	2602	Basic Geology Lab	1
O	2607	Meteorology-Climatology	3
O	3102	Boat Handling & Navigation	1
O	3104	Cartographic Lab	1
O	3105	Underwater Archeology	3
O	3201	Chemical Oceanography	3
O	3202	Chemical Oceanography Lab	2
O	3301	Biological Oceanography	3
O	3303	Biological Oceanography for Engineers	3
O	3401	Physical Oceanography	3
O	3601	Geological Oceanography	3
O	3631	Mineralogy	3
O	3632	Mineralogy Lab	1
O	3633	Petrology-Petrography	3
O	3634	Petrology-Petrography Lab	1
O	3642	Geoscience Lab	1
O	4101, 2, 3	Selected Topics in Oceanology	1, 2, 3
O	4104	Research Diving	2
O	4111	Oceanology Seminar	1
O	4197, 8, 9	Marine Field Projects	1, 2, 3
O	4203	Saline Water Analysis	3
O	4305	Bio-Environmental Oceanography	3
O	4405	General Dynamic Oceanography	3
O	4615	Geochemistry	3
O	4621	General Geophysics	3
O	4623	Geophysical Methods	3
O	4650	Marine Mineral Resources	3
O	4703	Fundamentals of Remote Sensing	3
O	4705	Oceanographic Instrumentation	3
O	4707	Data Collection and Analysis	3
O	4709	Oceanographic Data Processing	3
O	4991, 2, 3	Directed Studies	1, 2, 3

O 4994	Senior Project I	1
O 4995, 6	Senior Project II, III	2, 3

GRADUATE COURSES

O 5100	Marine Field Projects	6
O 5106	Principles of Oceanology	3
O 5101, 2, 3	Selected Topics in Oceanology	1, 2, 3
O 5110	Symposia	1
O 5111	Oceanography Seminar	1
O 5201	Principles of Chemical Oceanography	3
O 5202	Instrumental Analysis of Sea Water	3
O 5203	Advanced Chemical Oceanography	3
O 5204	Marine Pollution Analysis	3
O 5301, 2	Marine and Estuarine Phytoplankton I, II (2 hrs. lecture, 3 hrs. laboratory)	3, 3
O 5303, 4	Marine and Estuarine Zooplankton I, II (2 hrs. lecture, 3 hrs. laboratory)	3, 3
O 5305	Principles of Bio-environmental Oceanography	3
O 5306	Elements of Biological Oceanography for Teachers	3
O 5307, 8	Marine and Estuarine Benthos I, II (2 hrs. lecture, 3 hrs. laboratory)	3, 3
O 5401	Principles of Physical Oceanography	3
O 5403	Ocean Wave Theory	3
O 5405	Dynamic Oceanography	3
O 5406	Elements of Physical Oceanography for Teachers	3
O 5407	Tides and Tidal Currents	3
O 5409	Marine Thermodynamics	3
O 5413	Coastal and Estuarine Processes	3
O 5421	Physical Fluid Dynamics I	3
O 5423	Physical Fluid Dynamics II	3
O 5601	Principles of Geological Oceanography	3
O 5603	Marine Meteorology	3
O 5615	Marine Geochemistry	3
O 5621	Marine Geophysics	3
O 5641	Marine Sedimentation	3
O 5701	Optical Oceanography	3
O 5707	Sea Lab Techniques	3
O 5709	Numerical Analysis of Biological Data	3
O 5801	Coastal Systems Planning	3
O 5803	Legal-Environmental Relationships	3
O 5991, 2, 3	Directed Studies	1, 2, 3
O 5996	Internship	3
O 5997, 8, 9	Thesis Research	1, 2, 3
O 6999	Dissertation Research	36

UNDERGRADUATE COURSES IN OCEAN ENGINEERING

OE 2501	Design Concepts	2
OE 3521	Fluid Mechanics I	3
OE 3522	Fluid Mechanics II	3
OE 3551	Theory of Structures	3
OE 3581	Fluid Mechanics Lab I	1
OE 3582	Fluid Mechanics Lab II	1
OE 4511	Oceanology Seminar	1
OE 4518	Protection of Marine Materials	3
OE 4521	Coastal Engineering-Waves	3
OE 4523	Coastal Engineering-Sedimentation	3
OE 4524	Coastal Engineering Lab	1
OE 4525	Coastal Engineering-Structures	3
OE 4531	Instrumentation and Measurement Analysis	3
OE 4541	Ocean Engineering Design	3
OE 4542	Ocean Engineering Systems	3
OE 4545	Hydroacoustics	3
OE 4553	Computer Applications	3
OE 4554	Design of Shell Structures	3
OE 4582	Hydroacoustics Lab	1
OE 4583	Experimental Stress Analysis Lab	1
OE 4591, 2, 3	Directed Studies	1, 2, 3
OE 4594	Senior Project I	1
OE 4595	Senior Project II	2
OE 4596	Senior Project III	3
OE 4597, 8, 9	Marine Field Projects	1, 2, 3

GRADUATE COURSES

OE 5500	Marine Field Projects	6
OE 5511	Ocean Engineering Seminar	1
OE 5516	Principles of Ocean Engineering	3
OE 5518	Marine Corrosion	3
OE 5542	Ocean Engineering Systems	3
OE 5544	Principles of Hydroacoustics	3
OE 5551	Advanced Mechanics of Materials	3
OE 5552	Experimental Stress Analysis	3
OE 5563	Port and Harbor Engineering	3
OE 5591, 2, 3	Directed Studies	1, 2, 3
OE 5599	Thesis Research	3

Ph.D. IN OCEANOGRAPHY

The degree of Doctor of Philosophy in Oceanography may be taken in either of two options, Physical Oceanography or Bio-Environmental Oceanography. A student choosing one of these areas as his major field will in addition be expected to develop a general knowledge of the various areas of oceanography. A student who has received a Master of Science degree in mathematics, natural science, engineering, or the equivalent preparation is eligible to apply for admission to the Ph.D. program. All applicants should have an excellent scholastic record in their Master's degree program (3.30/4.00) from an institution of acceptable academic standing. If special circumstances exist the applicant may appeal to the Graduate Faculty for a waiver of the 3.30/4.00 requirement.

The degree of Doctor of Philosophy in Oceanography may be conferred upon students who satisfy the following requirements:

1. Successfully complete 72 credits beyond the requirements for the M.S. degree;
2. Meet the foreign language requirement;
3. Pass a comprehensive examination;
4. Complete a program of significant original research; and
5. Prepare and defend orally a dissertation concerning the research.

The program of study must be approved by the student's advisory committee and the Head of the Department of Oceanography and Ocean Engineering. A wide degree of latitude is allowable in course selection and research interest within the capability of the university and the student's academic background.

The instructional staff for the courses listed above consists of the following:

OCEANOGRAPHY

Andrews, T.J., M.S., Assistant Professor
Anzai, T., M.S., Assistant Professor
Breeding, J.E., Ph.D., Associate Professor
Dubbelday, P.S., Ph.D., Professor

Fainstein, R., Ph.D., Assistant Professor
Morris, F.W., Ph.D., Assistant Professor
Norris, D.R., Ph.D., Associate Professor
O'Hara, N.W., Ph.D., Professor and Head
Pierce, R.H., Ph.D., Associate Professor
Roberts, T.W., Ph.D., Assistant Professor
Stauble, D.K., Ph.D., Assistant Professor
Trefry, J.H., Ph.D., Assistant Professor

OCEAN ENGINEERING

Anzai, T., M.S., Assistant Professor
Blatt, J.H., Ph.D., Assistant Professor
Dubbelday, P.S., Ph.D., Professor
Fainstein, R., Ph.D., Assistant Professor
Kalajian, E.H., Ph.D., Associate Professor
Morris, F.W., Ph.D., Assistant Professor
O'Hara, N.W., Ph.D., Professor and Head
Schwalbe, J.W., M.S., Assistant Professor
Stauble, D.K., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Graduate Admissions
Florida Institute of Technology
Melbourne, Florida 32901

or,

Dr. N.W. O'Hara, Head
Department of Oceanography and Ocean
Engineering
Florida Institute of Technology
Melbourne, Florida 32901

THE JENSEN BEACH CAMPUS

The Jensen Beach campus of the Florida Institute of Technology borders the Indian River in the town of Jensen Beach on Florida's east coast. On its 84 acres are 22 buildings, including two modern residence halls, classrooms, laboratories, shop facilities, auditorium, chapel, library, student center, swimming pool, tennis courts and athletic fields. A cafeteria, snack bar and rathskeller are open while the students are in residence. Small sailboats are located on campus for student use. The new Student Center contains student affairs offices, admissions, student government, yearbook offices, lounges, post office, music room and a weight and exercise room. The Rathskeller contains a game room, beer and wine bar, dance floor and is the center of most student functions.

In addition to its classrooms, laboratories, and a new port facility, the school has four ocean vessels. The LCM-6, a 58-foot landing craft was acquired from the U.S. Navy and is modified to serve as a diver training vessel. She is twin-screw diesel powered and will accommodate diver trainees and instructors. The Joie de Vivre, a 45-foot, diesel-powered vessel, is equipped with oceanographic equipment and marine electronic instrumentation and accommodates a scientific party of ten, plus the ship's crew. The Aquarius, a 65-foot, steel diesel-powered research vessel is fully equipped and designed for long-range ocean cruises and accommodates a scientific party of twelve, plus the ship's crew. The Waft, a 55-foot, twin-screw, diesel-powered vessel is a marine training vessel and accommodates 10 students, 2 faculty members, and a ship's crew. The school also maintains a number of small river craft that are used for training purposes and river research projects.

Among the many fine facilities located on the campus is the full-equipped Dive Complex. This facility consists of a scuba equipment dive-locker, a surface supplied diving equipment locker, maintenance and repair work areas, a swimming pool, a 20-foot deep training tank, and a 15-foot deep underwater cutting and welding tank. Two recompression chambers are also located in this facility.

The degrees currently offered include:

1. Associate of Science (Oceanographic Technology, Offshore Marine Technology, Electronics Technology, Underwater (Commercial Diving) Technology, Petroleum Technology, Engineering Technology, Photographic Technology).

2. Bachelor of Science (Oceanographic Technology, Environmental-Aquaculture, Environmental Science Technology).

The Bachelor of Science degree program (B.S.) in Oceanographic Technology and Environmental Sciences-Aquaculture requires the successful completion of 200 and 184 hours, respectively.

Students in the Oceanographic Technology program are offered broadly-based training in the sciences and in the technical aspects of oceanography. Each of the major oceanographic disciplines is covered from both the theoretical and the practical viewpoint. Sampling methods, instrumentation and equipment are demonstrated in the classroom and in the field.

The four-year programs in Environmental Science Technology feature courses in advanced pollution technology, basic engineering, community planning and computer use, as well as specialization in Aquaculture, including fisheries management.

The Associate of Science degree programs (A.S.) in Oceanographic Technology, Offshore Marine Technology, Electronics Technology, Underwater (Commercial Diving) Technology, Engineering Technology, Photographic Technology and Petroleum Technology require the successful completion of 102, 100, 103, 105, 98, 98, and 96 hours, respectively.

All candidates for the degree of Bachelor of Science or Associate of Science must complete the minimum course requirements as outlined in the appropriate curricula with a 2.0 cumulative average. One hundred and seventy-four students graduated from these programs during the 1978 academic year.

Approximately three quarters of the 900 students at the Jensen Beach Campus are enrolled in marine oriented programs. During the 1978-1979 academic year, 115 students received degrees in Oceanographic Technology, 17 in Aquaculture, 27 in Offshore Marine Technology, and 53 will receive their degree in Underwater Technology.

Special summer programs in diving, underwater photography and marine ecology are frequently available.

Courses offered in conjunction with the above programs include:

Marine Biology I	3
Marine Biology II	3
Ichthyology	3
Identification of Marine Organisms	3
Parasitology in Aquaculture	3
Vertebrate Zoology	3
Genetics	3
Marine Ecology	3
Descriptive Chemistry	3
Ocean Chemistry I	3
Ocean Chemistry II	3
Ocean Chemistry III	3
Basic Scuba	1
Intermediate Scuba	2
Scuba Techniques I	2
Scuba Techniques II	3
Introduction to Recompression Chamber	2
Advanced Scuba	4
Underwater Emergency Medical Treatment I	1
Underwater Emergency Medical Treatment II	1
Recompression Chamber Operations	2
Diving Physiology	3
Underwater Cutting	3
Helmet and Dress Repair	3
Introduction to Surface Supplied Diving	4
Surface Supplied Diving I	3
Surface Supplied Diving II	3
Surface Supplied Diving III	3
Mixed Gas Diving I	2
Mixed Gas Diving II	2
Hot Water Diving	3
Introduction to Oceanography	2
Practical Oceanography	1
Nautical Science and Navigation	3
Piloting and Electronic Navigation	3
Rules of the Road	2
Radar Observer	2
Offshore Oil Technology	2
Offshore Navigation	3
Seamanship	3
Marine Power Systems	3
Marine Meteorology	3
Rigging and Seamanship	3
Ocean Structures I	3
Ocean Structures II	3
Oceanographic Equipment I	3
Oceanographic Instrumentation I	3
Seawater Analysis I	3
Seawater Analysis II	3
Electronic Navigation I	3
Electronic Navigation II	3
Celestial Navigation	3
Marine Cargo and Tankerman	3
Marine Internal Combustion Engines	3
Marine Electronic Communications	3
Marine Industries	3
Marine Engineering	3
Advanced Seamanship	3
Offshore Drilling	3
Safety Offshore	2
Offshore Management	3
Marine Auxiliaries	3
Motorboat Operation	3
Offshore Support Vessel Operations	3
Ocean Geology	3
Physical Oceanography I	3
Meteorology	3
Ocean Project I	4
Ocean Project II	4
Oceanographic Equipment II	3
Physical Oceanography II	3
Oceanographic Engineering I	5
Oceanographic Engineering II	5
Underwater Acoustics	3
Underwater Structures	3
Electrical Principles I	3
Electrical Principles II	3
Electron Devices	3
Electronic Communication	3
F.C.C. License Preparation I	3
F.C.C. License Preparation II	3
Fundamentals of Electronic Instruments	3
Electronics Laboratory I	1
Electronic Troubleshooting	3
Electronic Project	3
Electronics	3
Digital Logic I	3
Digital Logic Lab	1
Digital Logic II	3
Advanced Electronics I	5
Advanced Electronics II	5
Applied Electronics I	3
Applied Electronics II	3
Marine Archeology	3
Aquaculture I	1
Aquaculture II	3
Ecology I	4
Ecology II	4
Aquaculture Project I	3
Aquaculture III	3
Practical Aquaculture	2
Fisheries Management	3
Aquaculture Seminar	3
Aquaculture Project II	3

Instructional staff includes the following:

Booth, L.R., M.Ed., Assistant Professor of Industrial Arts
Burns, J.M., Instructor in Marine Science
Camperman, J.M., M.S., Instructor in Oceanography
Dinsmore, D.A., B.A., Instructor in Underwater Technology
Figueredo, L.E., M.S.E.E., Assistant Professor of Electronics
Frye, J.E., M.S., Instructor in Oceanography
Gehring, W.R., Ph.D., Assistant Professor of Biology, Dean of Academic Affairs
Gerstell, M.D., M.S., Assistant Professor of Mathematics and Head of the Department of Oceanographic Technology
Gilio, J.L., M.S., Assistant Professor of Chemistry and Biology
Hackney, J., B.A., Instructor in Industrial Arts
Hillen, J.P., M.A., Assistant Professor of Biology
Hitron, J.W., M.S., Assistant Professor of Environmental Science
Hogg, R.G., Ph.D., Assistant Professor of Environmental Science
Irwin, F.B., U.S. Navy, Instructor in Underwater Technology
Kasper, J.W., A.S., Instructor in Underwater Technology
McCoy, R.G., B.A., Instructor in Underwater Technology
Mortensen, R.H., M.S., Lecturer in Ocean Engineering
Noble, A.D., B.S.E.S., Instructor in Underwater Technology
Oestreich, T., Ph.D., Assistant Professor of Chemistry
Pettit, G.A., M.S., Instructor in Biology
Roderick, G.N., M.S., Instructor in Oceanography
Soule, D.J., B.A., Instructor in Underwater Technology
Tate, W.H., M.S.A., Assistant Professor of Marine Science

Tealey, E.E., M.S., Professor of Oceanographic Technology and Executive Director of the Jensen Beach Campus
Vallance, C.A., B.S., Instructor in Underwater Technology
Wade, F.L., Instructor in Industrial Technology
Woodberry, J.W., B.S., Instructor and Diving Officer in Underwater Technology

To obtain further information, address inquiries to:

Mr. Kevin Jones, Director
Admissions
Florida Institute of Technology
School of Applied Technology
1707 N.E. Indian River Drive
Jensen Beach, Florida 33457
(305) 334-4200

FLORIDA INTERNATIONAL UNIVERSITY
Miami, Florida 33199

Florida International University is one of the newest of the nine institutions in the State University System of Florida. There are currently two campuses with a combined enrollment of over 11,000 students. Most of these are advanced undergraduates although the University is preparing to allow freshmen and sophomores to enter as well. Several departments have ongoing master's degree programs.

The marine science curriculum is designed as an undergraduate certificate program. The concept of a certificate is similar to a "minor" except that it is multi-disciplinary in its approach and requires somewhat more credit hours of work. The certificate is designed to meet the needs of students who have declared a major in the natural sciences, environmental sciences or engineering. The traditional disciplines of biology, chemistry, physics and geology are reflected in the four courses required for the certificate in marine sciences. The broad background, in turn, prepares students for work in technical fields, for advanced graduate work, or for secondary school teaching. All of these major disciplines have ongoing or beginning master's degree programs.

Facilities

FIU is a member of the Florida Institute of Oceanography, headquartered at the University of South Florida in St. Petersburg. FIO's 63-foot research vessel Bellows is available for use in conjunction with coursework and research. Students enrolled in OCB 3010L spend several days at sea performing a variety of oceanographic operations.

Laboratory facilities at FIU are available for tissue culture, electron microscopy, virology and microbiology. A recirculating seawater system and radioisotope laboratory are also available. Chemistry facilities include mass, IR, NMR and UV-visible spectrometers, gas and liquid chromatographs and glass-blowing facilities. The earth sciences, physics and engineering programs have additional facilities which serve to meet the needs of students with interests in these fields.

Upper or Lower Division Preparation

Two quarters of Inorganic Chemistry with laboratory
Two quarters of Biological Science with laboratory

A minimum of 35 and a maximum of 39 credits will be required for the certificate program. Courses taken here will count toward science electives within the major as well as toward the 90 quarter hours required for the bachelor's degree.

The following courses are offered in conjunction with the above programs:

UPPER DIVISION PROGRAM

Required Courses (in quarter hours):

OCB 3010	Biological Oceanography	5
OCB 3010L	Biological Oceanography Lab	2
GLY 4730	Marine Geology	5
GLY 4730L	Marine Geology Lab	1
OCE 3014	Physical Oceanography	5
OCC 3002	Chemical Oceanography	5
OCC 3002L	Chemical Oceanography Lab	2
		25

Plus two of the following electives:

MCB 4735	Marine Microbiology	5
MCB 4735L	Marine Microbiology Lab	2
GLY 5793	Caribbean Shallow-Marine Environments	5
ZOO 3203	Marine Invertebrate Zoology	5
ZOO 3203L	Marine Invertebrate Zoology Lab	2
EVS 3268	Marine Technology	5
OCB 5635	Coral Reef Ecology	5
OCB 5635L	Coral Reef Ecology Lab	2
ZOO 5625	Biology of Crustaceans	5
ZOO 5625L	Biology of Crustaceans Lab	2
EVS 3420	Environmental Instrumentation	5

The instructional staff for the courses listed above includes the following:

Goldberg, Walter, Ph.D., Marine Ecology; Coral Biology
Makemson, John, Ph.D., Marine Microbiology; Bioluminescence
Maurrasse, Florentin, Ph.D., Marine Geology, Sedimentology; Micropaleontology
McLaughlin, Pat, Ph.D., Systematics; Crustacean Biology
Sheldon, John, Ph.D., Optical Oceanography; Fluid Mechanics
Thorhaug, Anitra, Ph.D., Marine Botany; Marine Ecology
Tracey, Martin, Ph.D., Marine Population Genetics

To obtain further information, address inquiries to:

(Please see next page)

Dr. Walter M. Goldberg
Florida International University
Department of Biological Sciences
Marine Science Program Coordinator
Tamiami Campus
Miami, Florida 33199
(305) 552-2201

FLORIDA STATE UNIVERSITY
Tallahassee, Florida 32306

DEPARTMENT OF OCEANOGRAPHY

The primary purpose of the Department of Oceanography of the Florida State University at Tallahassee is to administer a program of academic studies and associated research leading to the M.S. and Ph.D. degrees in Oceanography. The areas of specialization at Florida State include biological, chemical, and physical oceanography.

Oceanography Department headquarters, offices and laboratories are in the Oceanography/Statistics Building, located in the science area on the west side of the campus. Additional laboratories are in temporary quarters nearby and in the Nuclear Research Center. An Antarctic Marine Geology Research Facility located in the Geology Building on campus acts as a national repository for the storage of cores and a laboratory within the facility enables students and staff to analyze these cores being collected by the National Science Foundation Antarctic Research Program. Research conducted in conjunction with the Geophysical Fluid Dynamics Institute is housed in the FGDI laboratories in the Keen Building. In common with other departments on campus, classes are conducted in these or nearby buildings. The University computing center, equipped with a CDC Cyber 73 and CDC 74 computer, is available for instructional and research purposes.

The coastal laboratory for Florida State University is the Edward Ball Marine Laboratory on the Gulf of Mexico, 43 miles southwest of Tallahassee. The marine facility, constructed in 1968, includes laboratories for geochemical, microbiological, geological, physiological and ecological oceanographic research as well as a lecture hall and limited dormitory space for visiting personnel and students. The Bellows, a sea-going research vessel 65-feet long provided by the State of Florida, and a number of smaller craft are moored at the marine station. Deep-sea operations are frequently carried out through cooperative arrangements with other oceanographic institutions.

Library facilities on the main campus are excellent, and an additional reference library is maintained at the marine station.

An applicant for admission to the Department of Oceanography Graduate program must hold, or be a candidate for a baccalaureate degree from an approved college or university and be in good standing in the school last attended, present evidence of an average of B or better in both undergraduate and prior graduate academic work and attain a score of 1,110 on the Verbal Aptitude and Quantitative Aptitude Tests of the Graduate Record Examination.

Graduate students working toward a degree in oceanography are expected to acquire a basic background in all aspects of oceanography and at the same time to develop a high level of excellence in their chosen specialty, e.g., chemical, physical, or biological oceanography or some combination of these. An applicant must elect a tentative area of specialization in oceanography and should have substantial undergraduate work in at least one of the following areas: biology, chemistry, engineering, geology, mathematics, meteorology or physics.

All graduate students will normally be expected to have completed mathematics through differential and integral calculus, an equivalent of one year of physics, and one year of chemistry; additional prerequisites may be set by the specialty areas within the department, such as physical chemistry, advanced applied mathematics, and advanced geological or biological subjects. The student's prior training should support the chosen area of specialization.

The thesis-type Master's program is required in oceanography. Fifty-four quarter hours are required, made up of 45 quarter hours of coursework and nine quarter hours of thesis. The Department of Oceanography makes no mandatory department-wide requirement of any foreign language for the M.S. degree. In specific cases, however, a student's advisory committee may require demonstration of foreign language skills appropriate to the student's specialty.

The department requires that each student preparing for the M.S. degree attain a grade of A or B in each of the introductory survey courses.

The Ph.D. degree in Oceanography is not awarded upon the completion of any specific number of courses or at the end of any specified period. Candidates must demonstrate that they have mastered the field of oceanography and are capable of doing independent scholarly research leading to a dissertation which should be a contribution to the science of oceanography. A student planning study toward the Doctor of Philosophy degree in the Department of Oceanography must first be admitted by the department explicitly for such study.

The candidate for the Ph.D. degree will usually take 27 quarter hours of formal coursework in areas related to his specialty, in addition to the general M.S. requirements. Under unusual circumstances a student may be permitted to work toward the Ph.D. degree without completing the M.S. degree, but in that case the M.S. minimum course requirement of 45 quarter hours must be fulfilled.

An interdepartmental graduate program of study related to oceanography is offered leading to the Doctor of Philosophy degree in Geophysical Fluid Dynamics. The program is supported by the research programs and facilities of the Geophysical Fluid Dynamics Institute. The fields of oceanography, geology, meteorology and mathematics are included in this graduate program. Inquiries should be directed to the program director, Geophysical Fluid Dynamics Institute, 18 Keen Building, Florida State University.

The Department of Biological Science has developed a marine biology program which places less emphasis on the broad interdisciplinary aspects of oceanography (physics, mathematics and chemistry) and more emphasis on special biological problems. Students interested in such a program should write to the associate chairman for Graduate Studies of the Department of Biological Science, Florida State University.

Courses offered in connection with the above programs include:

DEPARTMENT OF OCEANOGRAPHY

UNDERGRADUATE COURSES

MET 1050	Air and Water Pollution Mechanisms
OCB 4651	Pollution Biology
OCE 1001	Elementary Oceanography
OCE 2111	Ocean Resources
OCE 3011	Principles of Oceanography
OCE 3012	Marine Climatology
OCE 4905r	Directed Individual Study

GRADUATE COURSES

I. Biological Oceanography

BOT 5425	Marine Phytoplankton Physiological Ecology
MCB 5735	Marine Microbiology
MCB 5765	Geomicrobiology
OCB 5050	Elementary Biological Oceanography
OCB 5624	Marine Ecosystem Dynamics
OCB 5634	Destructive Marine Organisms and Their Environmental Impact
OCB 5646	Oceanic Biogeography
OCB 5650C	Estuarine Pollution
OCB 5722	Fishery Biology
OCB 5720	Mariculture
PCB 5315	Primary Production of Aquatic Environments
PCB 5319	Marine Food Chains
PCB 5475	Deep Sea Ecology
PCB 5475L	Deep Sea Ecology Laboratory
ZOO 5565	Zooplankton Ecology
ZOO 5845	Estuarine Biology

II. Chemical Oceanography

OCC 5050	Elementary Chemical Oceanography
OCC 5052	Marine Chemistry -- Inorganic and Physical Aspects
OCC 5062	Marine Chemistry -- Radioactivity and Isotopic Aspects
OCC 5315	Marine Chemistry -- Bio-organic Aspects
OCC 5416	Organic Chemistry
OCC 5490	Applied Biogeochemistry
OCC 5554	Chemistry of Atmospheric Gases
OCC 5615r	Special Problems in Chemical Oceanography
OCC 5715r	Water Quality Dynamics

III. Geological Oceanography

OCG 5050	Elementary Geological Oceanography
OCG 5090r	Special Problems in Geological Oceanography
OCG 5276	Environments of Marine Deposition

IV. Physical Oceanography

EOC 5626	Experimental Oceanography
MAP 5431	Introduction to Fluid Dynamics
MAP 6434r	Advanced Topics in Hydrodynamics
MET 5307	Fluid Dynamics: Geophysical Applications
OCP 5051	Elementary Physical Oceanography
OCP 5053r	Special Problems in Physical Oceanography
OCP 5056	Introduction to Physical Oceanography
OCP 5163	Ocean Waves
OCP 5253	Dynamics of Incompressible Flow
OCP 5261	Ocean Circulation
OCP 5262	Dynamics of the Upper Ocean
OCP 5271	Turbulence
OCP 5285	Dynamic Oceanography
OCP 5287	Marine Hydrodynamics
OCP 5293	Estuary and Coastline Hydrodynamics
OCP 5551	Physics of the Air-Sea Boundary

V. General

OCE 5908r	Directed Individual Study
OCE 5910r	Supervised Research
OCE 5939r	Oceanography Seminar
OCE 5940r	Supervised Teaching
OCE 5971r	Thesis
OCE 6939r	Seminar
OCE 6980r	Dissertation
OCE 8966	Master's Comprehensive Examination
OCE 8976	Master's Thesis Defense
OCE 9964	Preliminary Doctoral Examination
OCE 9985	Dissertation Defense
STA 5937r	Environmental Statistics Seminar

The instructional staff for the courses listed above consists of the following:

Andreae, Meinrat O., Ph.D., Assistant Professor, Chemical Oceanography
Burnett, William C., Ph.D., Assistant Professor, Chemical Oceanography
Froelich, Philip N., Ph.D., Assistant Professor, Chemical Oceanography
Hsueh, Ya, Ph.D., Associate Professor, Physical Oceanography
Iverson, Richard L., Ph.D., Associate Professor, Biological Oceanography
Krishnamurti, Ruby, Ph.D., Professor, Physical Oceanography
LaRock, Paul A., Ph.D., Associate Professor, Biological Oceanography
Menzel, R. Winston, Ph.D., Professor, Biological Oceanography
O'Brien, James J., Ph.D., Professor, Meteorology and Physical Oceanography
Staley, Raymond C., Ph.D., Associate Professor, Physical Oceanography
Sturges, Wilton, Ph.D., Professor, Physical Oceanography, Chairman
Thistle, David, Ph.D., Assistant Professor, Biological Oceanography
Thompson, Rory, Ph.D., Professor, Physical Oceanography
Weatherly, Georges L., Ph.D., Associate Professor, Physical Oceanography
Winchester, John W., Ph.D., Professor, Chemical Oceanography

To obtain further information, address inquiries to:

Admissions Committee
Department of Oceanography
Florida State University
Tallahassee, Florida 32306
(904) 644-6700

DEPARTMENT OF BIOLOGICAL SCIENCE

The Marine Science Program in the Department of Biological Science offers coursework and degrees at three levels: B.S., M.S. and Ph.D. Undergraduate majors in the Department may specialize in marine biology after completing their lower division requirements. Seniors and beginning graduate students participate in our Saturation Course in Marine Biology which is given every spring quarter at the Florida State University Marine Laboratory on the Gulf Coast at Turkey Point. Students live at the marine lab and engage in coursework, research projects and field trips full-time during the quarter. The faculty for the course consists of both Florida State University personnel as well as invited lecturers from other universities.

The requirements for the B.S. degree include the the following: thirteen quarter hours of introductory biology, five quarter hours of genetics, four quarter hours of physiology, three quarter hours of ecology, three quarter hours of evolutionary biology, six quarter hours of mathematics, twenty quarter hours of chemistry, twelve quarter hours of physics and twenty quarter hours of electives in the Department of Biological Science.

The M.S. and Ph.D. programs permit a broad range of coursework and research opportunities in the following areas: behavior of marine organisms, marine ecology, estuarine biology, coral reef biology, invertebrate zoology, ichthyology, comparative physiology, radiation biology, marine microbiology and microbial ecology, pollution biology, electron microscopy and ultrastructure of marine organisms, sensory physiology, coelenterate biology, crustacean biology, molluscan biology, developmental biology, marine symbioses and parasitology and marine botany. Interdisciplinary programs exist between the Department of Biological Science and the Departments of Oceanography, Psychology (Psychobiology Program) and the Institute of Molecular Biophysics.

1. M.S. degree requirements include the following: at least forty-five quarter hours of graduate degree work including coursework recommended by the student's committee and research credit, service as a graduate assistant in the undergraduate program, reading knowledge of one foreign language or graduate level credit in mathematics or statistics, a comprehensive examination and submission of a research thesis.

2. Ph.D. degree requirements include the following: reading knowledge of two foreign languages or approved credit in mathematics and/or statistics, service as a graduate assistant in the undergraduate program, completion of the preliminary doctoral examination, 18 hours of research credit and submission and defense of a dissertation.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES (also available to graduate students)

ZOO 3713	Comparative Vertebrate Morphology	5
ZOO 4203	Invertebrate Form and Function	5
ZOO 4234	Principles of Symbiosis and Parasitism	4
ZOO 4253	General Marine Biology	5
ZOO 4343	Biology of Lower Vertebrates	4
ZOO 4353	Biology of Higher Vertebrates	4
ZOO 4513	Introduction to Animal Behavior	4
APB 4403	Radiation Biology	4
APB 4743	Water Pollution Biology	3
BOT 3223	Plant Anatomy	4
BOT 3343	Algae, Fungi, Lichens	4
BOT 4414	Marine Botany	4
PCB 3043	Introduction to Ecology	4
PCB 3253	Introduction to Animal Development	4
PCB 3613	Introduction to Evolution	4
PCB 3743	Vertebrate Physiology	4
PCB 4023	Cell Biology	4
PCB 4233	Immunology	4
PCB 4303	Limnology	4
PCB 4333	Biogeography	3
PCB 4424	Population Biology	4
PCB 4453	Biosystematics	4
PCB 4723	Comparative Animal Physiology I	4
PCB 4833	Neurophysiology	5

GRADUATE COURSES (also available to selected undergraduate students)

BOT 5535	Photobiology	3
BOT 5715	Plant Taxonomy	4
BOT 5938	Selected Topics In Botany	1-4
BOT 6936	Seminar in Botany	2
BSC 5346	Physiological Ecology and Behavior of Marine Organisms	4
BSC 5347	Comparative Physiology and Biochemistry of Marine Animals	4
BSC 5348	Neurobiology and Cellular Function of Marine Animals	4
EOC 5080	Application of Diving to Research	4
MCB 5156	Comparative Microbiology	4
BSC 6922	Departmental Colloquium	1
PCB 5395	Physiological Ecology of Fishes	4
PCB 5726	Comparative Animal Physiology II	4
PCB 5836	Advanced Neurophysiology	4
PCB 5931	Selected Topics in Ecology and Evolutionary Biology	1-4
PCB 5937	Selected Topics in Physiology	1-4
PCB 6936	Seminar in Physiology	2
PCB 6938	Seminar in Ecology and Evolutionary Biology	2
PSB 5071	Selected Topics in Psychobiology	1-4
PSB 6070	Current Problems in Psychobiology	2
PSB 6920	Psychobiology Colloquium	1
ZOO 5456	Ichthyology	4
ZOO 5515	Contemporary Animal Behavior	5
ZOO 5932	Selected Topics in Marine Biology	1-4
ZOO 5935	Selected Topics in Zoology	1-4
ZOO 6933	Seminar in Marine Biology	2
ZOO 6934	Seminar in Zoology	2

The full-time faculty involved in the above courses and the marine science research programs in the Department of Biological Science are as follows:

Abele, Lawrence, Ph.D., Miami, Associate Professor
Beidler, Lloyd, Ph.D., Johns Hopkins, Professor
Easton, Dexter, Ph.D., Harvard, Professor
Elam, John, Ph.D., Minnesota, Associate Professor
Friedmann, Imre, Ph.D., Vienna, Professor
Graziadei, Pasquale, Ph.D., Pavia (Italy), Professor
Greenberg, Michael, Ph.D., Harvard, Professor
Heard, William, Ph.D., Michigan, Associate Professor
Herrnkind, William, Ph.D., Miami, Professor
Hofer, Kurt, Ph.D., Vienna, Associate Professor
Livingston, Robert, Ph.D., Miami, Associate Professor
Mariscal, Richard, Ph.D., Berkeley, Professor
Schatten, Gerald, Ph.D., Berkeley, Assistant Professor

Short, Robert, Ph.D., Michigan, Professor
Simberloff, Daniel, Ph.D., Harvard, Professor
Strong, Donald, Ph.D., Oregon, Associate Professor
White, David, Ph.D., Tufts, Professor
Wiese, L., Ph.D., Tubingen, Professor
Williams, Theodore, Ph.D., Princeton, Professor
Yerger, Ralph, Ph.D., Cornell, Professor

To obtain further information, address inquiries to:

Dr. Richard N. Mariscal
Associate Chairman for Graduate Studies
Department of Biological Science
Florida State University
Tallahassee, Florida 32306
(904) 644-3023

FULLERTON COLLEGE
Fullerton, California 92634

Standard laboratory facilities and classrooms, ship time donated by local institutions and government agencies and visits to regional industrial facilities provide instructional situations.

The Fullerton College program in oceanographic technician training is designed to prepare entry-level technicians in marine-oriented operations. The curriculum grants the Associate in Arts degree, enabling students to transfer to senior institutions to pursue an academic rather than a vocational-technical goal.

In-year and summer experiences with shipboard or on-shore work programs provide the student with actual on-the-job conditions and credits for up to eight units.

The following courses are offered in conjunction with the above program:

1	General Biology	5
25	Marine Biology	3
49A	Life Sciences Independent Study	1
49B	Life Sciences Independent Study	1
49C	Life Sciences Independent Study	1
30	Introduction to Ocean Science	3
32A	Oceanographic Materials and Instruments	3
32B	Oceanographic Materials and Instruments	3
33	Navigation-Drafting	4
54	Cooperative Oceanographic Technology	2-8
A	Trigonometry and Elementary Functions	5
1	Physical Geology	3
1L	Physical Geology Lab	1
3	Introduction to Chemistry	5
2A	College Physics	3
2B	College Physics	3
3A	College Physics Laboratory	1
3B	College Physics Laboratory	1
1A	General Zoology	5
1B	General Zoology	5
5A	Principles of Biology	4
5B	Principles of Biology	4
81A	Technical Mathematics	3
81B	Technical Mathematics	-
10	Elementary Physics	4
43	Marine Electronics Instrumentation	3

To obtain further information, address inquiries to:

Howard Craig, Coordinator
Oceanographic Technology Program
Fullerton College
321 East Chapman Avenue
Fullerton, California 92634

THE GEORGE WASHINGTON UNIVERSITY
Washington, D.C. 20006

The University offers marine science courses at its main campus in downtown Washington, D.C. and at a number of off-campus facilities within easy reach of the University.

The Bachelor of Science degree in Oceanography is offered by and under the jurisdiction of the Columbian College, the liberal arts college of the University, and is administered by the College of General Studies. All students are required to satisfy the undergraduate requirements for the Bachelor of Science degree. In addition, specialization in oceanography is obtained by taking a minimum of 21 hours in oceanography and additional work in biology, chemistry, geology, geophysics, mathematics and physics. The students take the professional courses in oceanography at the off-campus facilities. Students attending these classes are expected to make their own arrangements for transportation. The balance are taken on-campus by full-time students; these students participate in all normal University activities.

The following courses are offered in conjunction with the above program:

OCEA 11	Navigation	3
OCEA 101	Elementary Oceanography 1	1
OCEA 102	Elementary Oceanography 2	3
OCEA 105	Elementary Geophysics	3
OCEA 106	Physical Science Data Analysis	3
OCEA 107	Introduction to Meteorology	3
OCEA 110	Physical Oceanography	3
OCEA 111	Ocean Waves and Tides	3
OCEA 112	Biological Oceanography	3
OCEA 113	Marine Geophysics	3
OCEA 114	Chemical Oceanography	3
OCEA 115	Geological Oceanography	3
OCEA 120	Coastal Ecology	3
OCEA 122	The United States and the Oceans	3
OCEA 124	Introduction to the Law of the Sea	3
OCEA 130	Fisheries Biology and Management	3
OCEA 132	Environmental Influences on Marine Living Resources	3

OCEA 135	Oceanographic Instrumentation	3
CART 107	Physiography	3
CART 108	Climatology	3

Students must complete Math 31-Calculus of one Variable and Physics 1-Foundations of Physics prior to the second year.

The instructional staff for the courses listed above include the following:

Anderson, Neil R., Ph.D., Professorial Lecturer
Earle, Marshall, Ph.D., Associate Professorial Lecturer
Hicks, Steacy D., M.S., Associate Professorial Lecturer
Morrison, Robert E., Ph.D., Associate Professorial Lecturer
Orlin, Hyman, Ph.D., Program Advisor and Professorial Lecturer
Rucker, James B., Ph.D., Professorial Lecturer

To obtain further information, address inquiries to:

Dr. Hyman Orlin
College of General Studies
The George Washington University
706 20th Street, N.W.
Washington, D.C. 20006

SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Physical facilities include: hydromechanics laboratory (tilting bed water channel, cavitation tunnel), sedimentation laboratory, water treatment laboratory, materials science laboratory (MTS fatigue testing system, scanning electron microscope, computing facilities (HP 3000, VAX-11, computer graphics). Some thesis research is carried out at the David Taylor Ship Research and Development Center, Carderock, Maryland and at the U.S. Corps of Engineers Coastal Engineering Research Center, Fort Belvoir, Virginia.

The Department of Civil, Mechanical and Environmental Engineering offers programs of graduate study in hydromechanics, ocean, marine and coastal engineering leading to the Master of Science, Professional and Doctor of Science degrees. Each program is arranged to fit a student's individual needs and interests and to utilize previous experience and background. This background should normally include an undergraduate degree in engineering, the physical sciences, or applied mathematics.

Number of degrees awarded (Master of Science) during the past academic year was one.

GRADUATE COURSES

ApSc 211	Analytical Methods in Engineering I	3
ApSc 212	Analytical Methods in Engineering II	3
ApSc 213	Analytical Methods in Engineering III	3
ApSc 214	Analytical Methods in Engineering IV	3
ApSc 215	Analytical Methods in Engineering V	3
ApSc 216	Special Topics in Engineering Analysis	3
CE 203	Prestressed Concrete Structures	3
CE 206	Foundation Engineering	3
CE 208	Rock Engineering	3
CE 212	Open Channel Flow	3
CE 213	Hydraulic Structures	3
CE 214	Design of Dams	3
CE 216	Advanced Hydrology	3
CE 219	Groundwater and Seepage	3
CE 253	Failure and Reliability Analysis of Engineering Structures	3
CE 255	Coastal Processes	3
CE 256	Introduction to Ocean and Coastal Engineering	3
CE 257	Harbor and Coastal Engineering I	3
CE 258	Harbor and Coastal Engineering II	3
CE 265	Special Topics in Geotechnical Engineering	3
CE 274	Mechanics of Water Waves	3
CE 275	Special Topics of Ocean Engineering	3
CE 282	Hydraulic Modeling	3
CE 298	Research	3
CE 299-300	Thesis Research	3-3
CE 310	Sedimentation Engineering	3
CE 311	Mechanics of Alluvial Channels	3
CE 312	Advanced Hydraulics	3
CE 398	Advanced Reading and Research	3
CE 399	Dissertation Research	Arranged
Eng 228	Physical Oceanography	3
Eng 260	Random Process Theory in Engineering	3
Eng 273	Time Series Analysis	3
Geol 181	General Oceanography	3
ME 215	Theory of Vibrations	3
ME 218	Design of Floating and Submerged Marine Vehicles	3
ME 221	Intermediate Fluid Mechanics	3
ME 2[illegible]	Viscous Flow	3
ME 231	Hydrodynamics	3
ME 277	Numerical Methods in Fluid Mechanics	3
ME 297	Special Topics in Fluid Mechanics	3
ME 312	Theory of Turbulence	3

The instructional staff for the courses listed above consists of the following:

CIVIL ENGINEERING

Feir, J.E., Ph.D., Professor
Mahmood, K., Ph.D., Professor
Yang, J.N., D.Sc., Professor

MECHANICAL ENGINEERING

Garris, C.A., Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. J.E. Feir
Associate Dean
School of Engineering and Applied Science
The George Washington University
Washington, D.C. 20052
(202) 676-7179

GEORGIA INSTITUTE OF TECHNOLOGY
Atlanta, Georgia 30332

MARINE SCIENCE CENTER AND SKIDAWAY INSTITUTE OF OCEANOGRAPHY
Skidaway Island, Savannah, Georgia

The Georgia Institute of Technology offers programs of Marine Science and Engineering at the Marine Science Center of the University System of Georgia located on the north end of Skidaway Island. Skidaway Island covers an area of 12 square miles, including highlands, estuaries, and salt marshes, and is approximately 18 miles from downtown Savannah. It is connected to the mainland by a bridge and causeway. The open sea is eight miles away via the Wilmington River. The Center includes the University of Georgia's Marine Resources Center and the Skidaway Institute of Oceanography, a research facility of the University System.

Courses are conducted in the Marine Resources Center which has four teaching laboratories, a running seawater laboratory, lecture and conference rooms, offices, two general laboratories, educational exhibits, and 12 large aquaria containing examples of the fauna in Georgia coastal waters. The library, located in the Skidaway Institute of Oceanography, includes over 7,000 volumes, 350 serials, and has access to the Computer Center on the University of Georgia campus at Athens.

A 14 by 32-foot flat-top boat, powered by twin outboard motors, and equipped for hauling shrimp nets, plankton nets, dredges, etc., is reserved for instructional purposes. Other University System boats include the 75-foot Bluefin and the 36-foot Morgan J. at Skidaway Island. The Georgia Tech School of Biology maintains a 22-foot research boat, the R/V Thurston, at the Skidaway Institute of Oceanography.

The following degrees are offered:

1. M.S. in Biology with specialization in Marine Biology.

   a) Thirty-three quarter hours of approved coursework and a minimum of 17 quarter hours of thesis.
   b) Completion of a thesis based upon original research.
   c) A comprehensive written examination and a thesis defense.

2. M.S. in Geophysical Sciences with specialization in Marine Geochemistry or Marine Geology.

   a) Thirty-three quarter hours of approved coursework and a minimum of 17 quarter hours of thesis.
   b) Completion of a thesis based upon original research.
   c) A thesis defense.

3. Ph.D. in Geophysical Sciences with specialization in Marine Geochemistry and Marine Geology.

   a) A program of study including a major area with no specified requirements and a minor area of at least 15 quarter hours.
   b) Demonstration of proficiency in a foreign language.
   c) Completion of a dissertation based upon original research, generally carried out at the Skidaway Institute.
   d) A comprehensive examination and a final oral defense of dissertation.

The following courses are offered in conjunction with the above programs. Courses followed by an asterisk (*) are offered at the Skidaway Marine Science Center. Others are offered at the Georgia Tech campus in Atlanta. Special Topics and Special Problems courses may be offered at both sites.

UNDERGRADUATE COURSES

Biol.	3335	General Ecology	3
Biol.	3336	General Ecology Laboratory	1
Biol.	3350	Invertebrate Zoology	4
Biol.	3351	Field Invertebrate Zoology	1
Biol.	3352*	Marine Invertebrate Zoology	5
Biol.	4423	Population Biology	3
Biol.	4425*	Marine Population Biology	4
Biol.	4426*	Estuarine Ecology	5
Biol.	4427*	Ichthyology	5
Biol.	4960-1-2*	Special Problems	Arranged
Geo.S.	2300	Survey of Oceanography	3
Geo.S.	4300	Introduction to Physical and Chemical Oceanography	3
Geo.S.	4301*	Applied Oceanography	5

GRADUATE COURSES

Biol.	6619	Ecological Systems	3
Biol.	6622	Special Topics in Ecology	2
Biol.	6624	Systems Ecology	3
Biol.	8023-4-5	Seminar in Ecology	2
Biol.	8101-2-3-4-5*	Special Topics	Arranged
Biol.	8504-5-6	Special Problems	Arranged
Geo.S.	6300	Principles of Physical Oceanography	3
Geo.S.	6310	Principles of Chemical Oceanography	3
Geo.S.	6764	Ocean Acoustics	3

The instructional staff for the courses listed above includes the following:

BIOLOGY

Benke, Arthur C., Ph.D., Associate Professor
Branham, Joseph M., Ph.D., Adjunct Assistant Professor
Gillespie, David M., Ph.D., Director of Education, Marine Science Center and Assistant Professor
Scott, Donald D., Ph.D., Adjunct Professor
Tenore, Kenneth, Ph.D., Adjunct Associate Professor

GEOPHYSICAL SCIENCES

Atkinson, Larry P., Ph.D., Adjunct Associate Professor
Beck, Kevin C., Ph.D., Associate Professor
Blanton, Jackson O., Ph.D., Adjunct Associate Professor
Dainty, Anton M., Ph.D., Associate Professor
Harding, James L., Ph.D., Adjunct Assistant Professor
Lowell, Robert P., Ph.D., Assistant Professor
Maynard, Lafayette, Ph.D., Adjunct Associate Professor
Wallace, G.T., Ph.D., Adjunct Associate Professor
Windom, Herbert L., Ph.D., Associate Professor

To obtain further information, address inquiries to:

(Please see next page)

Dr. John W. Crenshaw, Jr., Director
School of Biology

or,

Dr. Charles E. Weaver, Director
School of Geophysical Sciences
Georgia Institute of Technology
Atlanta, Georgia 30332

GRAYS HARBOR COLLEGE
Aberdeen, Washington 98520

The Grays Harbor College campus is located on a hill commanding an impressive view of the cities of Aberdeen and Hoquiam, the Grays Harbor Estuary (one of the three largest on the West Coast of the United States), and in the distance, the Pacific Ocean.

The College offers a Fisheries and Game Technician program designed to give students the skills needed to carry on field and laboratory research studies in fisheries, wildlife management, water quality and pollution control.

There is a four-acre lake on campus which drains into Grays Harbor through the Chehalis River system. A valuable asset, the lake is utilized in salmon rearing projects. In addition to Grays Harbor, the College district includes Willapa Harbor, plus hundreds of lakes, rivers, and streams in its wooded terrain which provide both study and recreational opportunities. Grays Harbor College is involved in numerous contractual research projects that employ student technicians. Equipment for student use includes two Boston Whaler boats and 50-hp. motor, three canoes, two jon boats, backpact electroshocker, beach seines, variable mesh gill nets, four salmon gravel incubators, rearing troughs, veiticle incubators, floating rearing pen, and a vast assortment of biological sampling devices. Specialized water quality sampling equipment includes atomic absorption spectrophotometer, IR spectrophotometer, turbidometer, transmissometer, and several types of dissolved oxygen, salinity and pH meters. Larger 50-60-foot ocean going vessels are based through the local commercial and charter boat fleet (over 400 vessels combined) at Westport (the salmon and soon-to-be bottom fishing capital of the U.S. located 25 miles from campus).

Grays Harbor offers a technical and professional degree program. All two-year graduates receive an Associates of Science degree. Technical graduates find employment with various state and federal agencies and private industry. Other students following the professional track, which involves taking higher level science courses, transfer to four year institutions in pursuit of a bachelor of science degree in fisheries, wildlife management and/or environmental science.

The following degrees are offered:

1. Associate of Applied Arts. Ninety-three credit hours including three hours of physical education and a major in a technical field.

2. Associate of Science. Ninety-three credit hours including three hours of physical education and completion of a major in an approved curriculum.

The following courses are offered in conjunction with the above programs:

FISHERIES AND GAME MANAGEMENT TECHNOLOGY

First Year

Math 103	Intermediate Algebra	5
Chem 100, 101, or 102	Chemical Science	10
Biol 101, 102, or 111, 112	General Biology or Zoology	10
Biol 121	Introduction to Fisheries	2
Biol 110	Introduction to Forestry	2
Biol 120	Water Resources	3
Biol 225 or Envir 110	Ecology of Man's Environment	5
Speech 101	Introduction to Public Speaking	3
Electives		4
PE		2
		46

Second Year

Engl 101	Freshman Composition	5
Geol 101 or Ocean 101	Geology or Oceanography	5
Fish 220	Chemical Field & Laboratory Methods	6
Fish 221	Biological Field & Laboratory Methods	6
Fish 211	Aquaculture	3
Engl 150	Technical Writing	5
Biol 114	Marine Biology	5
Fish 215	Fisheries Biology	5
Biol 130	Game Management	5
Electives		2
PE		1
		48

Suggested Electives

Fish 57	Seamanship	3
Math 281	Statistical Analysis	5
DP 100	Introduction to Data Processing	3
Police 101	Administration of Justice	5
Pe 177	First Aid and Safety	3

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Clothier, Glen, Ph.D., Assistant Professor
Messmer, Louis, M.S., Professor
Robinson, Myles, Ph.D., Associate Professor
Smith, John, Ph.D., Professor

CHEMISTRY

Schoermer, Eugene, Ph.D., Professor

FISHERIES

Samuelson, Don, M.S., Commercial Fisheries Agent

OCEANOGRAPHY

Phipps, James, Ph.D., Professor

To obtain further information, address inquiries to:

Don Samuelson, Instructor
Fish and Game Management
Grays Harbor College
Aberdeen, Washington 98520
(206) 532-9020, ext. 317/318

GULF COAST COMMUNITY COLLEGE
Panama City, Florida 32401

Special facilities are housed in the new Division of Mathematics and Science Building. The College borders on a large bay and has two freshwater lakes on the campus. Two new biology laboratories have just been completed. Plankton nets, beach nets, trawls, testing sampling equipment, saltwater aquarium and a Marine Technology Boat are available for collecting of specimen.

The following degrees are offered:

1. Associate of Science in Marine Technology. This is a two-year degree. Students have two options in the sophomore year: the physical or the biological option. Students are encouraged to obtain practical field experience through the Cooperative Education courses for credit. Sixty-three semester hours are required to complete this program.

2. Associate of Arts in Pre-Oceanography. This program is intended to be preparation for transfer to and completion of a four-year program in oceanography. The student is required to take chemistry, physics, algebra, and trigonometry. It is recommended that the student take biology electives. Sixty-five semester hours are required to complete this program.

The following courses are offered in conjunction with the above programs:

OCB 2013	Marine Biology	4
OMT 1204	Ecology of the Sea	4
OMT 1203	Marine Laboratory Techniques	4
GLY 1010	*Physical Geology	3
OCE 1001	Fundamentals of Oceanography	3
PHY 1020	*Basic Physics	3
EGN 1120	Engineering Drawing	3
ETE 1010	D.C. Circuits	4
ETG 2520	*Mechanics	3
ETC 1321	*Surveying	4
ETE 1020	*A.C. Circuits	4
ETE 2140	*Electronic Devices	4
ZOO 1010	General Zoology	4
BOT 1010	General Botany	4
MCB 2010	Microbiology	4
CHM 1045	General Chemistry	4
CHM 1046	General Chemistry	4

(NOTE: Asterisk (*) refers to required courses in the physical option.)

The instructional staff for the courses listed above consists of the following:

MATH-SCIENCE DIVISION

Brown, W. Joe, M.A.T., Associate Professor, Biology
Etheridge, Sandra, M.A.T., Associate Professor, Chemistry
Everett, Hayes L., M.Ed., Associate Professor, Physical Science
Henry, Cordell, Chairman, Math-Science Division
Masters, Dale R., Assistant Professor, Biology

TECHNICAL DIVISION

Adams, Harry, M.S., Assistant Professor of Engineering
Jones, Robert, M.A., Chairman
Moss, Charles, B.S., Instructor, Electronics
Ram, A.J., M.S., Assistant Professor of Drafting

To obtain further information, address inquiries to:

Robert C. Jones
Technical Division
Gulf Coast Community College
5230 W. Highway 98
Panama City, Florida 32401
(904) 769-1551, ext. 215

GULF COAST RESEARCH LABORATORY
Ocean Springs, Mississippi 39564

The Gulf Coast Research Laboratory (GCRL) is a full-time research facility for the State of Mississippi and offers education and training in the marine sciences at both the undergraduate and graduate levels.

Located on the coast of the north central Gulf of Mexico, the Laboratory has 45 acres on its main campus in Ocean Springs, and another 21 acres in Biloxi. The main campus plant consists of modern well-equipped experimental laboratories, teaching laboratories, lecture rooms, living quarters, and maintenance shops. Nine large buildings are of brick, glass and masonry construction, air-conditioned and equipped with diesel generators for emergency electrical power. There is dormitory space for 70 students, a seven-room faculty

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residence, and a dining hall that serves three meals a day in summer.

The Laboratory has a permanent full-time staff of approximately 150 people, augmented in summer by visiting instructors and part-time help.

A fleet of vessels used for research and teaching includes the 65-foot R/V Gulf Researcher, 40-foot trawler Hermes, ten power craft having 50 to 210 hp. engines and ranging from 17 to 30 feet long, seven 16-foot skiffs and several aluminum boats under 14 feet. A new 90-foot research vessel with berths for 20 persons, able to work out of port for 15 days or longer, is under construction.

Other Facilities

A research collection contains over 150,000 specimens and over 2,250 species of tropical and subtropical fishes.

A reference library devoted chiefly to the marine sciences is considered one of the finest on the north central Gulf coast.

The Laboratory operates the Marine Education Center located six miles away in Biloxi. Located in a small temporary building, the center eventually will have space for both research and teaching but currently is maintaining exhibits of live and preserved specimens of plants and animals as a means of promoting interest in and knowledge of coastal zone life and habitats.

An oyster biology laboratory is located on land adjoining the Marine Education Center. Research and teaching related to the culture of oysters, clams and other marine invertebrates is carried on here.

The land in Biloxi also provides a 150-foot dock with deep water to serve the larger vessels.

Research Equipment

Siemens 1A electron microscope; Slee cryostate; IBM 1130 computer connected to the Xerox IX computer at the University of Southern Mississippi; LKB ultrotome; atomic absorption spectrophotometer; IR spectrophotometer; two gas chromatographs for pesticide, hydrocarbon and organic analysis and equipped with interface for data computer printout; ultraviolet spectrophotometer; gasflow Geiger counter; Zeiss photomicroscope II; fully-equipped photographic laboratory; total carbon analyser; salinometer; bathythermograph; specific ion meter; fully-equipped microbiology laboratory; electrophoresis apparatus; microfilm reader-printer; Marsh-McBirney current meter; recorder and probes; nansen bottles with reversing thermometers; Graf pen and tablet digitizer; Warburg respirometer; digimatic osmometer; chloridometer; thermostatic aquaria for controlled environment studies; closed controlled habitats for holding live fish for experiments; microcomputer; Zeiss invertoscope; refrigerated heavy duty centrifuge; Beckman refrigerated ultracentrifuge; Whirlpool portable dryer; chlorine titrimeter; Beckman oxygen analyser; three syringe pumps; Orion specific ion analyser; Orion printer for ion analyser; Sartorious balance (on order); STD profiler; XBT launcher; printer for Sartorius balance; fluorescence spectrophotometer; and research pH meters.

AFFILIATED INSTITUTIONS

The laboratory is not a degree-granting institution but credit for courses completed is transferred to a student's home institution.

Educational institutions affiliated with GCRL are as follows:

In-State

Alcorn State University, Lorman, MS
Belhaven College, Jackson, MS
Delta State University, Cleveland, MS
Jackson State University, Jackson, MS
Millsaps College, Jackson, MS
Mississippi College, Clinton, MS
Mississippi State University, Mississippi State, MS
Mississippi University for Women, Columbus, MS
Mississippi Valley State University, Itta Bena, MS
University of Mississippi, University, MS
University of Mississippi Medical Center, Jackson, MS
University of Southern Mississippi, Hattiesburg, MS
William Carey College, Hattiesburg, MD

Out-of-State

Auburn University, Auburn, AL
Arkansas Tech University, Russellville, AR
Hendrix College, Conway, AR
Berry College, Mount Berry, GA
North Central College, Naperville, IL
Iowa State University, Ames, IA
Wartburg College, Waverly, IA
Westmar College, LeMars, IA
St. Joseph's College, Rensselaer, IN
Louisiana State University, Baton Rouge, LA
Louisiana State University Medical Center, New Orleans, LA
McNeese State University, Lake Charles, LA
Northeast Louisiana University, Monroe, LA
Our Lady of Holy Cross College, New Orleans, LA
Southeastern Louisiana University, Hammond, LA
Central Methodist College, Fayette, MO
Northwest Missouri State University, Maryville, MO
Northeast Missouri State University, Kirksville, MO
Southeast Missouri State University, Cape Girardeau, MO
Southwest Missouri State University, Springfield, MO
Queens College, Charlotte, NC
Jamestown College, Jamestown, ND
Bowling Green State University, Bowling Green, OH
Southwestern Oklahoma State University, Weatherford, OK
Presbyterian College, Clinton, SC
Lambuth College, Jackson, TN
Memphis State University, Memphis, TN
Middle Tennessee State University, Murfreesboro, TN
Southwestern at Memphis, Memphis, TN
Tennessee Technological University, Cookeville, TN
Tennessee Wesleyan College, Athens, TN
Union University, Jackson, TN
University of Tennessee at Chattanooga, Chattanooga, TN
University of Tennessee at Martin, Martin, TN
University of Tennessee at Nashville, Nashville, TN
Southern Methodist University, Dallas, TX
Texas Lutheran College, Seguin, TX
University of Washington, Seattle, WA

COURSES OF INSTRUCTION

Some courses are offered only during the summer. Also offered the year-round are instruction and research programs leading to the M.S. and Ph.D. degrees in such areas as botany, chemistry, ecology, fisheries biology, microbiology, microscopy, morphology, parasitology, physiology, taxonomy and zoology. Courses available include:

UNDERGRADUATE

ZO	141	Introduction to Marine Zoology	4

UNDERGRADUATE OR GRADUATE

BOT	341	Marine Botany	4
BOT	441	Salt Marsh Plant Ecology	4
CH	461	Marine Chemistry	6
GEO	331	Physical Marine Geology	3
GEO	332	Chemical Marine Geology	3
MIC	452	Marine Microbiology	5
MS	400	Special Problems in Marine Science (undergraduate)	Arranged
MS	405	Special Topics in Marine Science (undergraduate)	Arranged
MSE	431	Basic Techniques in Marine Science for Teachers	3
MSE	432	Advanced Studies in Marine Science for Teachers	3
OCE	451	Introduction to Physical and Chemical Oceanography	5
ZO	361	Marine Invertebrate Zoology	6
ZO	362	Marine Vertebrate Zoology and Ichthyology	6
ZO	401	Special Problems in Advanced Histology	3-6
ZO	442	Marine Fisheries Management	4
ZO	443	Introduction to the Behavior and Neurobiology of Marine Animals	4
ZO	452	Marine Ecology	5
ZO	461	Parasites of Marine Animals	6
ZO	464	Marine Aquaculture	6

GRADUATE

MS	510	Seminar	1
MS	590	Marine Science for Law Students at the University of Mississippi	
MS	700	Special Problems in Marine Science (graduate)	Arranged
MS	705	Special Topics in Marine Science (graduate)	Arranged
MS	800	Graduate Research in Marine Science (Master's)	Arranged
MS	900	Graduate Research in Marine Science (Doctor's)	Arranged
OCE	541	Descriptive Physical Oceanography	4
ZO	530	Biological Electron Microscopy I	3
ZO	531	Biological Electron Microscopy II	3

The instructional staff, resident and visiting, consists of the following:

Ballard, Buena S., Ph.D., Professor, Dept. of Biology, Southwestern Oklahoma State University
Blase, William Joel, L.L.B., Consultant in Marine Law, Gulf Coast Research Laboratory
Cake, Edwin W., Jr., Ph.D., Head, Oyster Biology Section, Gulf Coast Research Laboratory
Channell, R.B., Ph.D., Professor of Biology, Vanderbilt University
Christmas, J.Y., M.S., Fisheries Research and Development Section, Gulf Coast Research Laboratory
Cliburn, J. William, Ph.D., Professor of Biology, University of Southern Mississippi
Cook, David W., Ph.D., Assistant Director for Administrative and Academic Affairs; Registrar and Head, Microbiology Section, Gulf Coast Research Laboratory
Corcoran, Gerald C., M.S., Curator, Marine Education Center, Gulf Coast Research Laboratory
Dawson, C.E., B.S., Ichthyologist and Research Museum Curator, Gulf Coast Research Laboratory
Domeski, Leo S., Ph.D., Associate Professor, Biological Sciences, University of Kentucky
Eleuterius, Charles K., M.S., Head, Physical Oceanography Section, Gulf Coast Research Laboratory
Eleuterius, Lionel N., Ph.D., Head, Botany Section, Gulf Coast Research Laboratory
Gunter, Gordon, Ph.D., Director emeritus and Professor of Zoology, Gulf Coast Research Laboratory
Hawkins, William E., Ph.D., Head, Microscopy Section, Gulf Coast Research Laboratory
Howse, Harold D., Ph.D., Director, Gulf Coast Research Laboratory
Lakshmi, Gaddam, Ph.D., Physiology Section, Gulf Coast Research Laboratory
Lawler, Adrian, Ph.D., Marine Biologist, Parasitology Section, Gulf Coast Research Laboratory
Lytle, Julia S., Ph.D., Head, Environmental Chemistry Section, Gulf Coast Research Laboratory
Lytle, Thomas F., Ph.D, Head, Analytical Chemistry Section, Gulf Coast Research Laboratory
McBee, James T., Ph.D., Ecology Section, Gulf Coast Research Laboratory
McIlwain, Thomas D., Ph.D., Assistant Director for Fisheries Research and Management, Gulf Coast Research Laboratory
Otvos, Ervin T., Ph.D., Head, Geology Section, Gulf Coast Research Laboratory
Overstreet, Robin, Ph.D., Head, Parasitology Section, Gulf Coast Research Laboratory
Richardson, Sally L., Ph.D., Fisheries Research and Development Section, Gulf Coast Research Laboratory
Venkataramiah, A., Ph.D., Head, Physiology Section, Gulf Coast Research Laboratory
Walker, William W., Ph.D., Microbiology Section, Gulf Coast Research Laboratory
Woodmansee, Robert A., Ph.D., Head, Ecology Section, Gulf Coast Research Laboratory

To obtain further information, address inquiries to:

The Director's Room
Gulf Coast Research Laboratory
P. O. Box AG
Ocean Springs, Mississippi 39564

HARVARD UNIVERSITY
Cambridge, Massachusetts 02138

The program in oceanographic education at Harvard University is primarily concerned with the training of scientists who wish to prepare for careers involving the pursuit or application of knowledge of modern ocean science at its research frontiers. The underlying educational philosophy is based upon the principle that such professional oceanographic scientists must necessarily be thoroughly trained in one of the basic exact sciences in which oceanography is rooted, while at the same time made aware of the breadth of ocean sciences and the special problems of dealing with the real natural medium. It is predominantly a graduate educational program with students pursuing the regularly offered advanced degrees in the basic scientific departments of the University, but with a special oceanic orientation.

The University maintains a cross-departmental Committee on Oceanography, but teaching and research in oceanography are carried out directly in the departments of the university devoted to the basic scientific field to which a particular branch of oceanography is related. The extensive laboratories of each of the science departments are available and equipped for work in almost all branches of physics, engineering and applied physics, applied mathematics, chemistry, geology and biology. The study collections in the botanical, zoological and geological museums are extremely rich in marine material, and the library facilities are unexcelled; especially valuable in these respects is the Museum of Comparative Zoology.

Extensive computer facilities are available at the University through the Center for Research in Computing Technology, the Office for Information Technology and via terminals directly linked to large computers elsewhere, e.g., the National Center for Atmospheric Research at Boulder, Colorado.

Of especial interest to graduate students in physical oceanography and geophysics is the Center for Earth and Planetary Physics, which consists of a group of faculty drawn from the Departments of Astronomy, Geological Sciences, and Physics and the Division of Applied Sciences with common interest in the application of physical and mathematical methods to the investigation of large-scale natural phenomena of the earth and solar systems. Geophysics, atmospheric physics and oceanography are all represented in the Center and interdisciplinary work is encouraged.

A fleet of sea-going ships and staff members experienced in the broad aspects of practical work at sea are available under the cooperative education program in oceanography between Harvard and the Woods Hole Oceanographic Institution. Under this program, qualified students registered for graduate work at Harvard or at the Woods Hole Oceanographic Institution have access as appropriate to courses of instruction, advice of staff, and use of research facilities at the other institution.

Other oceanographic facilities and courses of instruction are available through cooperative agreements with the Massachusetts Institute of Technology, the Marine Biological Laboratory at Woods Hole, the Bermuda Biological Station for Research, and the Massachusetts Department of Conservation (Division of Marine Fisheries), the U.S. Fish and Wildlife Service, and other oceanographic institutions.

The Faculty of the Committee on Oceanography at Harvard University adheres to the principle that the oceanographer should be thoroughly qualified in one of the classical scientific disciplines. His studies of the phenomena of the ocean proceed as a specialty within, or as an extension of, one of these fields of learning. As a consequence, there is no department of oceanography at Harvard, but members of the Committee on Oceanography will assist students who wish to prepare themselves for work in this special field. At the undergraduate level, the student is expected to arrange courses within the framework provided in the usual fields of concentration. Graduate students will ordinarily meet the requirement for the higher degrees within one of the existing divisions of the faculty, but if their programs necessarily bridge two or more established departments, their degrees may be administered by a joint committee composed of members of the departments concerned.

The following degrees are offered for studies in:

1. Biological Oceanography and Marine Biology. M.S. (or M.A.) and Ph.D. in Biology from the Department of Biology and M.S. (or M.A.) and Ph.D. in Applied Physics or Applied Mathematics from the Division of Applied Sciences. Master's granted per year, four; Ph.D.'s per year, two.

2. Chemical Oceanography and Marine Geochemistry. M.S. (or M.A.) and Ph.D. in Applied Sciences from the Division of Applied Sciences, or A.M. and Ph.D. in Geophysics from the Department of Geological Sciences. Master's granted per year, one; Ph.D's granted per year, one.

3. Marine Geology and Geophysics. A.M. and Ph.D. in Geology or Geophysics from the Department of Geological Sciences. Master's granted per year, one; Ph.D.'s granted per year, one.

4. Physical Oceanography. M.S. (or M.A.) in Applied Sciences, Ph.D. in Applied Physics or Applied Mathematics from the Division of Applied Sciences; Ph.D. in Applied Mathematics from the Committee on Applied Mathematics; Ph.D. in Physics from the Department of Physics. Master's granted per year, three; Ph.D.'s granted per year, two.

Courses directly related to oceanographic sciences:

UNDERGRADUATE/GRADUATE

Biol 118	Biological Oceanography
Biol 123	Reproduction of Marine Invertebrates
Biol 130	Biology of Fishes
Biol 133	Biology of Mollusks
Biol 154	Population and Community Ecology
Biol 161	Environmental Physiology
Earth & Planetary Physics 102*	Introduction to Physical Oceanography
Eng Sci 123	Mechanics of Fluids
Eng Sci 171	Chemistry of the Aqueous Environment
Eng Sci 173	Introduction to Environmental Microbiology
Eng Sci 174	Concepts and Methods in Microbial Ecology
Geol 125	Chemical Oceanography
Geol 147	Physical Sedimentary Processes

* Earth & Planetary Physics courses are offered in the Division of Applied Sciences

UNDERGRADUATE

Biol 19	Population Biology: Ecology

GRADUATE

Biol 255	Nature and Regulation of Marine Ecosystems
Biol 256	Phytoplankton and Zooplankton Ecology
Biol 260	Structure and Function of Marine Invertebrates
Eng 221	Fluid Dynamics, II
Eng 273	Water Pollution Microbiology
Eng 274	Chemical Models of Natural and Polluted Waters
Earth & Planetary Physics 203a*	Physics and Chemistry of Atmospheres I
Earth & Planetary Physics 203b*	The Chemistry of Planetary Atmospheres
Earth & Planetary Physics 212*	Special Topics in Geophysical Fluid Dynamics
Earth & Planetary Physics 216*	Physical Oceanography
Geol 252	Sedimentary Petrology and Geochemistry

* Earth & Planetary Physics courses are offered in the Division of Applied Sciences

The instructional staff for the courses listed consists of the following:

DEPARTMENT OF BIOLOGY

Boss, Kenneth J. Ph.D., Professor of Biology, Curator in Malacology
Crompton, A.W., Ph.D., Professor of Biology
Fink, William L., Ph.D., Assistant Professor of Biology
Hastings, J. Woodland, Ph.D., Professor of Biology
Liem, Karel, Ph.D., Professor of Ichthyology
McCarthy, James J., Ph.D., Assistant Professor of Biological Oceanography
Sebens, Kenneth P., Ph.D., Assistant Professor of Biology
Taylor, C. Richard, Ph.D., Professor of Biology
Turner, Ruth, Ph.D., Professor of Malacology
Woollacott, Robert, Ph.D., Assistant Professor of Invertebrate Biology

DIVISION OF APPLIED SCIENCES

Bossert, William H., Ph.D., Gordon McKay Professor of Applied Mathematics
Butler, James N., Ph.D., Gordon McKay Professor of Applied Chemistry
Carrier, George F., Ph.D., T. Jefferson Coolidge Professor of Applied Mathematics
Fofonoff, Nicholas P., Ph.D., Gordon McKay Professor of the Practice of Physical Oceanography
Lindzen, Richard S., Ph.D., Gordon McKay Professor of Dynamical Meteorology
Mitchell, Ralph, Ph.D., Gordon McKay Professor of Applied Biology
Robinson, Allan R., Ph.D., Gordon McKay Professor of Geophysical Fluid Dynamics
Wofsy, Steven C., Ph.D., Associate Professor of Atmospheric Chemistry

DEPARTMENT OF GEOLOGICAL SCIENCES

Holland, Heinrich D., Ph.D., Professor of Geology
Siever, Raymond, Ph.D., Professor of Geology

To obtain further information, address inquiries to:

Allan R. Robinson, Chairman
Committee on Oceanography
Harvard University, Pierce Hall
29 Oxford Street
Cambridge, Massachusetts 02138
(617) 495-2819

HIGHLINE COMMUNITY COLLEGE
Midway, Washington 98031

Highline Community College offers a two-year (seven quarter) diving technology program to prepare students for employment in the offshore oil fields or in the ocean-related construction industries. The program, which leads to the Associate in Applied Science degree, utilizes comprehensive training in the underwater environment to give the student sufficient theoretical and practical education to obtain a starting job in the diving industry.

A newly-constructed diving pier on Puget Sound is owned and operated by the College as an integral part of the diving technology program. Year-round diving in open water allows the student to gain experience with contemporary diving helmets, masks, gas recirculators, and scuba gear.

The Wilson Mark IV Deep Diving System is used for training in Diver/Bell lock-outs and transfer under pressure, mixed-gas and console operations, and treatment/decompression procedures. In addition to instruction in diving, strong emphasis is placed on rigging, seamanship, piloting, ship construction, salvage principles, and small boat handling.

A course on blasting, with underwater application, is taught up to the level required for a state blaster's license. Students are required to obtain Lifesaving and Industrial First Aid certification as part of the course. Various engineering, welding, communications, and science courses are included in the program.

Special Admission Requirements

Before applying for admission, students must look beyond the glamour and excitement of the program to the realities of long hours of study, physical exertion and the potential hazards inherent in the undersea environment. Applicants for the diving technology program must complete a rigorous series of medical tests before they are admitted, and basic scuba certification is a prerequisite for entry.

Thorough screening for the program allows a maximum of 45 students to enroll for the first year and, of that number, only the top 24 are admitted to the second year. The risk factor must also be considered; water is a hostile environment -- claustrophobia and temptation to panic are ever present. Students are required to carry health and accident insurance and to sign a liability waiver. Minimum age for application is 18.

Obtain College application and Diving Technician application from Office of Admissions. Applications will be accepted December 1 through April 1 for the following Fall. Applicants will be notified of acceptance or rejection by June 1.

DIVING TECHNOLOGY PROGRAM CURRICULUM

FRESHMAN YEAR

Fall Quarter

MT	150	Diving Orientation	3
Engr	60	Blueprint Reading	3
Engr	70	Fundamentals	5
IT	130	Welding	5
PE	129	Lifesaving	2
			18

Winter Quarter

MT	160	Fundamentals of Work Diving	3
Engr	120	Construction	5
Ocean	100	Oceanography	5
IT	80	Power Mechanics	4
			17

Spring Quarter

IT	35	Industrial First Aid	3
IT	160	Machining, Divers	5
Engr	185	Hydraulics/Pneumatics	5
Writ	70	Communications	5
			18

Summer Quarter

MT	171	Marlinespike Seamanship	2
MT	181	Helmet Diving I	8
			10

SOPHOMORE YEAR

Fall Quarter

MT	172	Oilfield Working	2
MT	282	Helmet Diving II	8
MT	283	Lightweight Diving	8
			18

Winter Quarter

MT	173	Salvage Seamanship	2
MT	284	Diving Bell Systems	8
MT	285	Underwater Welding/Cutting	8
			18

Spring Quarter

MT	174	Underwater Blasting	2
MT	286	Underwater Work	8
MT	287	Mixed Gas Diving	8
			18

Recommended electives:
Engr 101, 105, 121; Math 71, 72; Writing 75, 145; Speech 80, 105; MT 175

Cost

Tuition is $10.20 per credit to a maximum of $102 ($39.60 per credit to $396 for non-residents) per quarter. There are extra expenses for equipment as described below.

The second year students will be expected to purchase specified equipment which may cost as much as $300. Before any substantial outlay of cash for equipment will be required, the student will have received some exposure to the rigors and demands of the program and a chance to learn about the career field. The student is measured by the instructors who will have had an opportunity to observe performance. Other costs include: books about $60; lab fees about $56; clothing and equipment about $300, and other about $10.

The instructional staff for the courses listed above consists of the following:

- Bray, Howard, Instructor, Welding
- Brown, David, Instructor, Machining
- Campbell, Spencer, Instructor, Diving Technology
- Maplestone, Robert, Instructor, Engineering Technology
- Powell, Roger B., PE, Instructor, Engineering Technology
- Robertson, Bruce, Instructor, Power Mechanics

To obtain further information, address inquiries to:

Admissions Office
Highline Community College
Midway, Washington 98031
(206) 878-3710, ext. 361

or,

Maurice Talbot
Program Director
Highline Community College
Midway, Washington 98031

HUMBOLDT STATE UNIVERSITY
Arcata, California 95521

The marine science program at Humboldt State University offers instructional and research opportunities in oceanography, marine fisheries and various aspects of marine biology. The proximity of the school and the HSU Marine Laboratory to a wide variety of marine environments offers the students ample field trip opportunity both for research and classroom work. The laboratory at Trinidad, 15 miles north of the main campus, includes a lecture room, three large teaching laboratories, a large research wet laboratory, graduate research spaces and a shop. A modern seawater system and various types of aquaria and trays serve the needs of the staff and students. Research vessels are chartered to support the marine science program. The on-campus facilities include a fish hatchery, water chemistry and ichthyology laboratories, a large fish collection, and zoology and botany classrooms and laboratories. In addition, a data processing center is available for student use. Equipment, technical guidance and financial aid are provided graduate students and some seniors through programs on marine sport fisheries conducted by the California Cooperative Fisheries Unit on campus.

The College offers the following degrees through the schools indicated:

DEPARTMENT OF OCEANOGRAPHY

Bachelor of Science in Oceanography. Requirements: general education (required and elective courses to insure cultural breadth in the humanities, social sciences and English and speech); lower division requirements in Math, Chemistry, Physics, Biology, Geology, and Statistics; upper division requirements (core courses plus 24 units of approved science electives); and free electives to bring the total number of units for the B.S. degree to 192 quarter units.

The following courses are offered in conjunction with the above program:

OCEANOGRAPHY

UNDERGRADUATE COURSES

OCN 100	General Oceanography	5
OCN 101	Biological Oceanography	4
OCN 102	Physical Oceanography	5
OCN 103	Chemical Oceanography	4
OCN 105	Marine Field Techniques	3
OCN 106	Geological Oceanography	4
OCN 110	Mankind and Life of the Sea	3
OCN 115	Celestial Navigation	3
OCN 116	Marine Sedimentation	5
OCN 120	Resources of the Sea	3
OCN 121	Zooplankton Ecology	4
OCN 125	Field Problems	1-3
OCN 126	Beach and Nearshore Processes	3
OCN 130	Contemporary Problems in Man's Use of the Marine Environment	2
OCN 131	Marine Radioecology	3
OCN 160	Environmental Framework of Estuaries	4
OCN 180	Oceanography Seminar	1
OCN 185	Undergraduate Seminar	1
OCN 190	Selected Topics in Oceanography	1-4
OCN 195	Field Cruise	4
OCN 199	Directed Study	1-3

GRADUATE COURSES

OCN 211	Dynamics of Marine Primary Production	3
OCN 260	Geology and Dynamics of Estuaries	4
OCN 261	Ecology of Estuarine Organisms	4

OCEANOGRAPHY FACULTY

Crandell, George F., Ph.D., Biological Oceanography, Professor

Gast, James A., Ph.D., Chemical Oceanography, Professor

Hodgson, Robert T., Ph.D., Physical Oceanography, Associate Professor

Pequegnat, John E., Ph.D., Biological Oceanography, Associate Professor and Department Chairman

Thompson, Robert W., Ph.D., Geological Oceanography, Professor

To obtain further information, address inquiries to:

Dr. John E. Pequegnat, Chairman
Oceanography Department
Humboldt State University
Arcata, California 95521

FISHERIES DEPARTMENT

1. Bachelor of Science in Fisheries. Requirements: general education (to insure breadth in the humanities, social sciences, English and (speech); lower division requirements in Math, Chemistry, Biology, Physics, computer usage, and statistics; upper division requirements (core courses plus 20 units of approved electives); and free electives to bring the total number of units for the B.S. degree to 192 quarter units.

2. Master of Science in Fisheries. Requirements: appropriate undergraduate degree; three specified courses; required thesis; plus approved graduate courses to bring units to 45 quarter units.

The following courses are offered in conjunction with the above programs:

FISHERIES

UNDERGRADUATE COURSES

FISH 100	Introduction to Fishery Biology	3
FISH 101	Introduction to Fishery Biology Practicum	1
FISH 110	Icthyology	5
FISH 111	Fish Physiology	4
FISH 114	Fisheries Literature and Report Writing	2
FISH 135	Ecology of Marine Fishes	4
FISH 143	Problems in Water Pollution Biology	3
FISH 150	Introduction to Fish Population Dynamics	3
FISH 160	Principles of Fisheries Management	3
FISH 170A	Fish Culture and Breeding	3
FISH 170B	Fish Culture Field and Laboratory Practicum	1
FISH 171	Fish Disease Management	3
FISH 175	Commercial Fisheries	3
FISH 180	Techniques in Fishery Biology	3
FISH 184	Fisheries Gear and Instrumentation	2
FISH 190	Selected Topics in Fisheries	1-4
FISH 195	Field Problems in Fisheries	1-4
FISH 198	Senior Fisheries Seminar	1
FISH 199	Directed Study	1-4

GRADUATE COURSES

FISH 240	Early Life History of Fishes	4
FISH 245	Economically Important Invertebrates	3
FISH 250	Advanced Fish Population Dynamics	3
FISH 260	Advanced Principles of Fisheries Management	3

FISH 265	Reservoir Biology and Management	3
FISH 271	Advanced Fish Disease and Pathology	4
FISH 290	Thesis	1-4
FISH 295	Research Problems in Fisheries	1-4
FISH 298	Graduate Fisheries Seminar	1

FISHERIES FACULTY

Allen, George H., Ph.D., Professor and Department Chairman
Barnhart, Roger A., Ph.D., Adjunct Professor and Unit Leader, California Copperative Fisheries Unit
DeWitt, John, Jr., Ph.D., Professor of Fisheries
Hankin, David, Ph.D., Assistant Professor of Fisheries
Hassler, Thomas J., Ph.D., Adjunct Assistant Professor of Fisheries
Hendrickson, Gary, Ph.D., Assistant Professor of Fisheries
Kerstetter, Ted., Ph.D., Professor of Biology
Roelofs, Terry D., Ph.D., Professor of Fisheries
Van Kirk, Robert R., Ph.D., Associate Professor of Natural Resources
Welsh, James P., Ph.D., Professor of Fisheries

To obtain further information, address inquiries to:

Dr. George Allen, Chairman
Fisheries Department
Humboldt State University
Arcata, California 95521

DEPARTMENT OF BIOLOGY

1. A.B. in Biology. Requirements: general educa- (requirements as listed in the catalogue to insure breadth in the humanities, social sciences, English and speech); lower division requirements (five specified courses); upper division requirements (three specified courses plus option).

2. Master of Arts in Biology. Requirements: bachelor's degree with a major in biology, botany, zoology or related subject area approved by the Department of Biology; overall undergraduate grade point average of 2.5 or a grade point average of 3.0 for the last 90 quarter units of credit; completion of 45 upper division or graduate units in biology or supporting courses approved by the graduate committee, including a minimum of 18 units of graduate courses; a preliminary examination by the graduate committee to be taken prior to registration for the last 30 units, and completion of a total of not less than eight or more than 10 units of 290 and 299 and a thesis approved by the graduate committee.

3. A.B. degree in Botany. Requirements: general education (to insure breadth in the humanities, social sciences, English and speech); lower division requirements (seven specified courses); upper division requirements (12 specified courses, plus electives).

4. A.B. degree in Zoology. Requirements: general education (to insure breadth in the humanities, social sciences, English and speech); lower division requirements (six specified courses); upper division requirements (nine specified courses).

The following courses are offered in conjunction with the above programs:

BIOLOGY, BOTANY AND ZOOLOGY

UNDERGRADUATE COURSES

Biol 141	Marine Biology	4
Biol 142	Intertidal Ecology	4
Bot 141	Phytoplankton Physiology and Ecology	3
Bot 145	Marine Phycology	4
Zool 112	Invertebrate Zoology	4
Zool 113	Invertebrate Zoology	4
Zool 143	Comparative Physiology	4

GRADUATE COURSES

Biol 200	Selected Topics in Biology	1-3
Bot 200	Selected Topics in Botany	1-3
Zool 200	Selected Topics in Zoology	1-4
Zool 242	Benthic Ecology	3
Zool 244	Invertebrate Embryology	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGY

Allen, William, Ph.D., Associate Professor of Zoology
Boyd, Milton, Ph.D., Lecturer in Biology
Brusca, Gary, Ph.D., Associate Professor of Zoology
DeMartini, John, Ph.D., Professor of Zoology
Houck, Warren, Ph.D., Professor of Zoology
Rasmussen, Robert, Ph.D., Associate Professor of Botany
Yarnall, John, Ph.D., Assistant Professor of Zoology

To obtain further information, address inquiries to:

Department Head
Department of Biology
Humboldt State University
Arcata, California 95521

THE JOHNS HOPKINS UNIVERSITY
Baltimore, Maryland 21218

The program in oceanography in the Department of Earth and Planetary Sciences at Johns Hopkins emphasizes physical oceanography, and is closely linked to the program in geophysical fluid dynamics. It also provides opportunities for exploring chemical oceanography (through the geochemistry program within the department) and marine biology (through the ecology program within the department). The department laboratories and shops are in Latrobe Hall, and are equipped with the general and specialized equipment required for oceanographic research. Photographic, drafting and data reduction facilities are available to the students; an extensive and active Computer Center is maintained on campus.

In addition, the resources of the Chesapeake Bay Institute, a division of the University engaged in oceanographic contract research, are available to students. The C.B.I. research vessels are docked at the Institute's field laboratory in Annapolis, Maryland, about an hour's drive from campus. The fleet includes the 106-foot catamaran R/V Ridgely Warfield, specifically designed for research in estuarine and coastal waters, as well as several smaller vessels.

The Department has an agreement which permits students to use the facilities of the Smithsonian Institution in Washington, D.C. should this be required for their research.

The Department accepts candidates for either an M.A. or Ph.D. program. Candidates for the M.A. program in oceanography must complete a prescribed program of coursework, demonstrate a reading knowledge in French, German, or Russian, complete an essay based on original work, and pass an oral examination before a committee of the department. Candidates for the Ph.D. will take such courses and meet such requirements as deemed necessary by their advisory committee, must satisfy the Department foreign language requirement, and must pass a comprehensive examination before a committee of department faculty, must pass an oral examination administered by the Graduate Board of the University, and must submit an acceptable dissertation based on original research. A year of residence at the University is required for all advanced degrees.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

27.321	Introductory Oceanography
27.325	Principles of Ecology
27.334	Quantitative Methods in Ecology and Paleobiology
27.365-366	Biology and Paleobiology of the Invertebrates

GRADUATE COURSES

27.611-612	Physical Meteorology and Oceanography
27.613	Ocean Waves
27.614	Atmospheric and Oceanographic Turbulence
27.617-618	Geophysical Fluid Mechanics II
27.620	Estuarine Oceanography
27.621	Advanced Dynamical Oceanography
27.625	Chemical Oceanography
27.638	The Ecology of Aquatic Benthos
27.642	Theoretical Ecology
27.649-650	Geophysical Fluid Mechanics
27.664	Aqueous Geochemistry

The instructional staff for the courses listed above includes:

Benton, George S., Professor, Dynamical Meteorology
Jackson, Jeremy B.C., Associate Professor, Marine Ecology
Long, Robert R., Professor, Fluid Mechanics
Phillips, Owen M., Professor, Fluid Mechanics and Oceanography
Olson, Peter L., Assistant Professor, Geophysical Fluid Dynamics
Stanley, Steven M., Professor, Paleobiology
Woodin, Sarah A., Assistant Professor, Marine Ecology

To obtain further information, address inquiries to:

Dr. George W. Fisher, Chairman
Department of Earth and Planetary Sciences
Johns Hopkins University
Baltimore, Maryland 21218

LAMAR UNIVERSITY
Beaumont, Texas 77710

Lamar University, through its Department of Biology, offers interdisciplinary work leading to the degree of Bachelor of Science in Oceanographic Technology, with options in Marine Biology, Marine Geology, and Ocean Engineering. While most of the classroom and laboratory facilities are on the main campus in Beaumont, the field work is based on a site in Port Arthur, on Sabine Lake, which is an excellent example of a coastal or estuarine environment. Teaching and research laboratories are equipped for both instructional work and student-oriented projects.

Most of the field activity is related to coastal environmental problems and are centered at the 40,000 square foot Pleasure Island facility where geological, biological and geochemical laboratories are established. Berthing facilities lie adjacent to the Pleasure Island laboratory where the 34-foot twin engined, steel catamaran, 20-foot glass inboard-outboard, and 23-foot twin outboard boats are kept. Smaller glass boats and aluminum skiffs are also available for river and shallow bay collection.

The 34-foot catamaran is rigged for shallow water coring, trawling, and dredging. Research equipment includes an induction salinometer, dissolved oxygen meter, Ekman current meter, otter and plankton trawl nets, pH meters, atomic absorption spectrometer, x-ray diffraction, microscopes and photographic equipment.

The following degree is offered:

B.S. in Oceanographic Technology. The requirements for this degree are as follows:

1. Meet general University degree requirements.
2. Completion of 131-134 semester hours.
3. Specialization of 21-28 semester hours in Biology, Geology, or Engineering option.

Degrees awarded during current academic year (16).

The following undergraduate courses are offered in conjunction with this program:

Bio	243	Microbiology	4
Bio	346	Invertebrate Zoology	4
Bio	443	Limnology	4
Bio	445	Marine Biology	4
Bio	446	Ecology	4
Bio	449	Protistology	4
Geo	341	Statistics, Data Processing	4
Geo	344	General Oceanography	4
Geo	361	Field Course	6
Geo	430	Physical Oceanography	3
Geo	433	Geophysics	3
Egr	114	Graphics	1
Egr	230	Statics	3
Egr	233	Circuits and Fields	3
Egr	234	Thermodynamics	3
CE	339	Soils Science	3
CE	331	Environmental Science	3
ChE	331	Momentum Transfer	3
EE	438	Instrumentation	3

The instructional staff for the various courses include the following:

BIOLOGY

Harrel, Richard C., Ph.D., Professor
McGraw, J.L., Ph.D., Professor
Robertson, P.B., Ph.D., Associate Professor
Runnels, W.C., Ph.D., Associate Professor

GEOLOGY

Fainstein, Roberto, Ph.D., Assistant Professor
Stevens, J.B., Ph.D., Associate Professor
Tennissen, A.C., Ph.D., Professor

ENGINEERING

DelFlache, A.P., Sc.D., Professor
Morgan, W.E., Ph.D., Associate Professor

PHYSICS

Pizzo, J.F., Ph.D., Professor
Shepherd, J.G., M.S., Associate Professor

To obtain further information, address inquiries to:

Dr. Roger E. Yerick, Dean
College of Sciences
Lamar University
P. O. Box 10022
Beaumont, Texas 77710

LEHIGH UNIVERSITY
Bethlehem, Pennsylvania 18015

Lehigh University has teaching and research facilities on the main campus at Bethlehem, Pennsylvania, and at a marine field station near Stone Harbor, New Jersey. The principal research facility is the Center for Marine and Environmental Studies at the main campus, including a marine biology laboratory, marine geology laboratory, and marine geotechnical laboratory for ocean engineering research. The off-campus facility, The Wetlands Institute, is equipped with a running salt water system, a Boston Whaler with outboard motor, and an inboard skiff. Research equipment includes salinometers, spectrophotometers, pH meters, microscopes, and biological sampling apparatus. On campus there is access to major items of research equipment through academic departments and other centers, including atomic absorption spectrophotometer, gas chromatography/mass spectrometer, scanning electron microscope, electron microprobe, x-ray diffractometer, and sediment size-analysis apparatus.

The following degrees are offered through the respective academic departments:

1. M.S. in Biology, specializing in Marine Biology.
2. M.S. in Geological Sciences, specializing in Marine Geology.
3. M.S. in Civil Engineering, specializing in Ocean Engineering.
4. Ph.D. in Biology, specializing in Marine Biology.
5. Ph.D. in Geological Sciences, specializing in Marine Geology.
6. Ph.D. in Civil Engineering, specializing in Ocean Engineering.

The minimum requirements for the master's degree include:

1. Not less than 30 semester hours of graduate work;
2. Not less than 18 hours of 400-level coursework;
3. Not less than 18 hours in the major field, of which at least 15 hours must be in 400-level courses; and
4. A thesis or a report based on a research course of at least three credit hours or no more than six hours (Biology also requires passing a departmental qualifying examination).

The minimum requirements for the doctorate are:

1. Passing a departmental general examination;
2. Sixty credit hours beyond the master's degree based on a program of work formulated by the candidate and a special committee, including research for a dissertation;
3. Oral and written presentation of a dissertation approved by the candidate's special committee; and
4. Passing a foreign language proficiency examination.

In the past academic year there were three marine-related master's degrees granted in Biology, and five in Geological Sciences; two marine-related Ph.D.'s in Biology, and one in Geological Sciences.

The following marine-related courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Biol 221	Undergraduate Research	3
Biol 241	Ecology of Wetlands (summer)	6
Biol 306	Ecology	3
Biol 341	Biology of Marine Animals (summer)	6
Chem 334	Chemical Oceanography	3
CE 332	Ocean Engineering	3
CE 333	Ocean Engineering Field Investigations	1-3
Geol 63	Introduction to Oceanography	3
Geol 211	Environmental Geology	3
Geol 281	Geological Research	1-6
Geol 315	Coastal Sedimentation	1
Phys 366	Ocean Physics	3

GRADUATE COURSES

Biol 405	Special Topics in Biology	1-3
Biol 407	Biological Research	3
Biol 408	Biological Research	3
Biol 417	Marine Ecology	3
Biol 418	Biological Oceanography	3
Biol 441	Marine Botany	3
Biol 442	Marine Zooplankton	3
Biol 480	Marine Science Seminar	1
CE 431	Geotechnical Ocean Engineering	3
CE 437	Advanced Topics in Geotechnical Ocean Engineering	1-3
CE 439	Ocean Engineering Research	1-6
Geol 461	Marine Geology	3
Geol 481	Geological Investigation	1-6
Geol 490	Special Topics	1-6

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Hargreaves, B.R., Ph.D., Assistant Professor
Herman, S.S., Ph.D., Professor
Hoagland, K. Elaine, Ph.D., Assistant Professor
Pritchard, H.N., Ph.D., Associate Professor

CHEMISTRY

Hughes, M.C., Ph.D., Assistant Professor

CIVIL ENGINEERING

Richards, A.F., Ph.D., Professor of Ocean Engineering and Oceanography

GEOLOGICAL SCIENCES

Carson, B., Ph.D., Associate Professor
Evenson, E.B., Ph.D., Associate Professor
Parks, J.M., Ph.D., Professor

PHYSICS

Van Sciver, W.J., Ph.D., Professor

Prospective graduate students should communicate directly with the chairman of the academic department of their choice (Biology, Civil Engineering, or Geological Sciences), as applicants must meet the requirements of and be accepted by the academic department in which they plan to earn an advanced degree.

To obtain further information, address inquiries to:

Dr. James M. Parks, Director
Center for Marine and Environmental Studies
Williams Hall, Building #31
Lehigh University
Bethlehem, Pennsylvania 18015

LONG ISLAND UNIVERSITY/SOUTHAMPTON COLLEGE
Southampton, New York 11968

The Division of Natural Sciences instructional, laboratory and research space approximates 22,800 square feet which includes a one-acre campus marine station of 5,800 feet with dockside facilities. Vessels owned and operated by the division include the Shawna IV, a 38-foot twin diesel research vessel which is equipped with radar, Loran, recording fathometer, s/s and CB radio, electrically driven one-ton capacity hydrographic winch with 1,000 feet of wire and a small wet laboratory. Additional research vessels include one 34-foot platform outboard powered vessel; one 30-foot sea skiff; four 19-foot and three 17-foot fiberglass utility boats. These vessels are equipped with winch, davit or A-frame and metering wheel, fathometers, and specialized sampling and collecting equipment as required for shallow water and estuarine work. Major marine laboratory instruments available include a three-channel technician auto-analyzer, a multichannel scintillation spectrophotometer, atomic furnace absorption spectrophotometer, anodic stripper, gas chromatography apparatus, x-ray crystallography apparatus, a salinometer, a sediment size analyzer and a fluorometer.

The Bachelor of Science in Marine Science is offered with concentrations in biological, chemical or geological areas of study. All marine science majors must take the following courses as prerequisites: Math 106, 201, 202 (college math through calculus); Physics 201-202, and Chemistry 101-102 (general), 201 (quantitative analysis).

All marine science majors must take the marine science sequence MS 309, MS 310, MS 390-391.

All majors must select one area of concentration from:

1. Biological: Bio 101 or 102 and one other from 101-105 or Geol 105; Bio 211, Chem 203, MS 341, two from Bio 201, 203, 204, 221 or 308 and two from Bio 206, 208, 210, 307, 314, 316, 321, 323, or 342.

2. Chemical: Chem 101-102 or Chem 111-112, 201, 203-204, 301-302, 304, Geol 302, MS 310

3. Geological: Geol 113-114, 201, 205, 215, one from 219 or 302, 306, 321, 338.

The number of marine science majors graduating in 1978-1979 was 75. In addition to the above programs, an environmental science major is offered which combines training in specific discipline and broad exposure to the social science aspects of environmental problems.

The following courses are offered in conjunction with the above programs:

MARINE SCIENCE DEPARTMENT

MS 107	Meteorology	4
MS 111	Introduction to Oceanography	4
MS 222	Fisheries Biology	4
MS 309	Physical Oceanography	4
MS 310	Chemical Oceanography	4
MS 311	Primary Productivity	4
MS 338	Marine Geology	4
MS 341	Marine Ecology	4
MS 390	Marine Operations and Research	6
MS 400	Independent Study	1-4

BIOLOGY DEPARTMENT

Bio 101	Cell Biology	4
Bio 102	Plant Biology	4
Bio 103	Animal Biology	4
Bio 104	Human Biology	4
Bio 105	Field Biology	4
Bio 201	Marine Phycology	4
Bio 203	Lower Invertebrates	4
Bio 204	Higher Invertebrates	4
Bio 206	Human Physiology	4
Bio 208	Developmental Biology	4
Bio 210	Microbiology	4
Bio 211	Genetics	4
Bio 221	Ichthyology	4
Bio 307	Endocrinology	4
Bio 314	Biochemistry	4
Bio 316	Parasitology	4
Bio 321	Comparative Physiology	4
Bio 323	Evolution	4
Bio 342	Ethology	4

CHEMISTRY DEPARTMENT

Chem 101-102	General Chemistry	4-4
Chem 111-112	Advanced General Chemistry	4-4
Chem 201	Quantitative Analysis	4
Chem 202	Instrumental Analysis	4
Chem 203-204	Organic Chemistry	4-4
Chem 301-302	Physical Chemistry	4-4
Chem 304	Advanced Inorganic Chemistry	4
MS 310	Chemical Oceanography	4

GEOLOGY DEPARTMENT

Geol 113	Mineralogy I	4
Geol 114	Mineralogy II	4
Geol 201	Igneous and Metamorphic Petrology	4
Geol 205	Structural and Field Geology	4
Geol 207	Coastal Processes	4
Geol 215	Sedimentation	4
Geol 219	Paleontology	4
Geol 302	Geochemistry	4
Geol 304	Hydrology	4
Geol 306	Geophysics	4
Geol 321	Global Tectonics	4
Geol 338	Marine Geology	4

One semester internships (up to 16 credits) are available to qualified juniors and seniors at major marine institutions on both the East and West Coasts.

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Coher, Edward J., Ph.D., Professor
Maresign, Thomas W., Ph.D., Professor
Liddle, Larry B., Ph.D., Professor
Reisman, Howard M., Ph.D., Associate Professor
Serafy, Keith, Ph.D., Assistant Professor
Welker, John R., M.S., Professor

CHEMISTRY

Goldberg, Arthur S., Ph.D., Associate Professor
Siegel, Alvin, Ph.D., Professor
Stern, David A., Ph.D., Assistant Professor

GEOLOGY

Balsam, William, Ph.D., Associate Professor
Berkebile, C. Alan, Ph.D., Professor
Eastin, Rene, Ph.D., Associate Professor
McCormick, C. Larry, Ph.D., Professor

PHYSICAL OCEANOGRAPHY

Posmentier, Eric, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. Alvin Siegel, Director
Marine Science Program
Southampton College
Southampton, New York 11968
(516) 283-4000, ext. 164

LOUISIANA STATE UNIVERSITY
Baton Rouge, Louisiana 70803

Marine Sciences education at L.S.U. is focused on the study, management and development of marshlands, estuaries, shallow-water environments and related resources typical of the coastal zone. The department and cooperating University organizations provide extensive aerial photograph and map collections, nuclear and computer science facilities, chemical analysis capabilities, biological and sedimentological laboratories and sampling equipment, boats and skiffs for nearshore operations, machine shops, photographic laboratories and library facilities.

Field operations in Louisiana are conducted from University-leased facilities near work sites or from those provided through cooperation with the extensive marshland refuge system operated by the Louisiana Wildlife and Fisheries Commission. A typical operations base may include living space for eight to 10 people and a portable laboratory building. Although larger boats can be berthed at nearby marinas, most field work is conducted with boats in the 16 to 24-foot class.

The Center for Wetland Resources at LSU serves as the University's primary agency for research and education in the marine and wetland fields. The Center was founded in 1970 and it brought together three of the University's marine-oriented agencies: Coastal Studies Institute (CSI), Department of Marine Sciences, and Office of Sea Grant Development. Recent additions are the Laboratory for Wetland Soils and Sediments and the Coastal Ecology Laboratory. In addition to its own education, research, and advisory services, the Center is committed to the encouragement and support of activities related to the wetlands theme throughout the University and State.

For more than two decades, the CSI has conducted coastal zone research under the auspices of the Geography Programs of the Office of Naval Research. Its research activities are truly international in scope. Sustained by ONR support, the Institute's scientists and technicians have amassed operational field experience on five continents and many insular provinces. As its ultimate objective, the CSI seeks the knowledge and methodology needed for measurement, analysis, and prediction of coastal environments around the world, as manifested by sea-air-land processes and associated morphological features. An extensive local program has developed with USGS Support.

The Department of Marine Sciences, created in 1968, has developed masters and doctoral programs for students interested in careers involving marine-related research, technology, resource utilization and education. Although a few of the department's courses are open to undergraduates, no baccalaureate degree program is offered. Courses and curricula in the department are concerned mainly with the marsh and shallow water environments of the Louisiana coast rather than the "bluewater" courses stressed elsewhere. The academic program is augmented by a wide choice of marine-related courses taught in other departments of the University. Several CSI and OSGD personnel serve as faculty members of the Department of Marine Sciences.

The Office of Sea Grant Development administers funds granted to the University by the Office of Sea Grant of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The Laboratory for Wetland Soils and Sediments researches sediment chemistry/plant relations in natural wetland ecosystems such as salt marshes, fresh and brackish marshes and swamps, and floodplains, and the chemical and biological behavior of plant nutrients and toxic substances in wetland ecosystems. The Coastal Ecology Laboratory emphasizes study of the emergent properties of large-scale ecological systems, systems that incorporate the interaction of geologic, hydrologic, and chemical processes in addition to biologic ones.

The following degrees are offered:

1. M.S. in Marine Sciences. In conjunction with requirements and scheduling specified in the current issue of the Bulletin of the Louisiana State University Graduate School the Master of Science degree in Marine Sciences requires:

a) A program of study approved by the Department Chairman and the student's major professor. The program will normally consist of a minimum of 24 hours of graduate-level courses and six hours of thesis research. Courses will include four core courses and at least four 7000 or 8000-level courses. In addition, a proficiency in calculus is required. Electives may be chosen with the consent of the student's major professor from appropriate courses in the Department of Marine Sciences or other departments.

b) Research culminating in the preparation of an acceptable Master's thesis which should demonstrate the capacity for originality of thought, research, and facility in organizing material.

c) An average grade not lower than B and no lower than C in the courses offered for the degree.

d) Passing a final oral examination based largely on the student's area of specialization, aspects of his research problem and past coursework.

e) Although a reading knowledge of a foreign language is not required of a candidate for the Master's degree, the major professor may recommend some exposure to a particular language if a large body of foreign-language literature exists in the candidate's specialty field. In some specialty fields, recommendations may be made to develop the student's proficiency in statistics, computer sciences, etc., rather than in a foreign language.

2. Ph.D. in Marine Sciences. In conjunction with requirements and scheduling specified in the current issue of the Bulletin of the Louisiana State University Graduate School the Doctor of Philosophy degree in Marine Sciences requires:

a) A program of study approved by the student's major professor and advisory committee consisting of (1) at least 48 hours of coursework beyond the baccalaureate. (Coursework will include four core courses plus a minimum of 24 hours of appropriate 7000 or 8000-level courses. In addition, the student must select a minor in another department -- or an internal minor approved by the Graduate Council. Electives may be selected from courses designed to complete the student's program of study.) (2) A maximum of 12 hours of research leading to a dissertation in some area of marine science.

b) An average grade not lower than B and no grade lower than C in the courses offered for the degree.

c) A reading knowledge of at least one language other than his native language. The language is normally to be selected from the following: (1) German, (2) Russian, (3) French, (4) Spanish, (5) English. The candidate's selection should be based upon the abundance of foreign-language scientific literature in his field of specialization.

d) Passing a comprehensive qualifying examination covering the student's scientific background and training, coursework, and general capabilities in the scientific field. This examination should be taken during the first semester after the Master's degree is awarded.

e) Passing a comprehensive general examination in a manner that conclusively demonstrates the student's competence over broad segments of marine sciences and a high degree of familiarity with current progress in one or more minor fields.

f) Passing an oral final examination based on the dissertation research.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF MARINE SCIENCES

4010-4011	Marine and Wetland Ecology for Teachers	3
4020	Introduction to Marine Sciences for Graduate Students	3
4126	Chemical Oceanography	3
4170	Physical Oceanography	3
4171	Coastal and Marine Meteorology	3
4372	Estuarine Ecology	3
4464	Marine Resources Law	1-4
4465	Seminar in Coastal Zone Management	1-4
7010	The Concepts of the Ecosystem	3
7016	Coastal and Shallow-Water Literature	3
7028	Numerical Modelling of Ocean Currents	3
7120	Introduction to Coastal Models	3
7122	Gravity Waves in Shallow Water	3
7125	Estuarine and Shallow-Water Oceanography	3
7127	Dynamics and Sedimentary Response-Features of Coastal Environments	3
7131	Geochemistry of Coastal Water, Soils, and Sediments	3
7132	Coastal Physical/Chemical Systems: Analytical Methods	3
7162	Coastal Climatology	3
7165	Chemistry and Microbiology of Flooded Soils and Sediments	2
7210	Form-Process Relationships in Coastal Environments	3
7241	Coastal Ecology	3
7246	Coastal and Estuarine Resources	3
7311	Marine and Estuarine Plankton	3
7317	Marine Ecology	3
7370	Seminar: Theoretical Concepts of Ecology	2
8000	Thesis Research	1-9
8900	Advanced Reading and Literature Research	1-6
8901	Advanced Field Research	1-6
9000	Dissertation Research	1-9

DEPARTMENT OF BOTANY

4046	Plant Ecology
7065	Mineral Nutrition of Plants
7066	Mineral Nutrition of Plants Laboratory

DEPARTMENT OF CHEMICAL ENGINEERING

4104	Transport Science: Momentum Transfer
4102	Transport Science: Heat and Mass Transfer
4294	Ecosystems Analysis
7276	Mathematical Analysis and Optimization of Natural Systems
7295	Advanced Topics in Chemical Engineering

DEPARTMENT OF CIVIL ENGINEERING

Hydraulic Engineering

4162	Fluid Mechanics
4163	Hydraulics
4165	Hydrology
7203	Free Surface Flow
7206	Advanced Hydraulics
7280	Advanced Hydrology
7290	Optimization Techniques in the Planning, Design and Operation of Water Resources Systems

ENGINEERING

4111	Environmental Engineering

ENGINEERING SCIENCE

7610	Materials for Marine Environments

DEPARTMENT OF EXPERIMENTAL STATISTICS

7001	Basic Statistical Methods
7002	Advanced Statistical Methods
7031	Principles of Experimental Design

DEPARTMENT OF FOOD SCIENCE

4001	Food Process Engineering
4043	Food Science
4044	Food Technology
4070	Food and Drug Laws, Standards, and Regulations
4075	Food Preservation
4082	Plant Metabolism
4086	Marine Food Resources and Technology
7030	Advanced Food Research - Marine Food Products
7071	Seminar in Food Science
7072	Seminar in Food Technology

SCHOOL OF FORESTRY AND WILDLIFE MANAGEMENT

Wildlife and Fisheries

4010	Fur Animal Management
4021	Limnology
4022	Fundamentals of Fish Culture
4061	Special Problems
7021	Advanced Game Management - Waterfowl
7020	Fish Parasites and Diseases
7021	Fishery Research Techniques
7022	Water Pollution Biology
7024	Shellfisheries Biology
7025	Mariculture
7028	Fisheries Hydrography

SCHOOL OF GEOSCIENCES

Geography and Anthropology

4001	Geography of Louisiana
4013	Meteorology

6014	Climatology
6015	Microclimatology
6019	Aerial Photo Interpretation I
6020	Aerial Photo Interpretation II
6021	Alluvial Geomorphology
6023	Coastal Morphology
6028	The Ocean World
6029	Marine and Coastal Resources
7960	Hydroclimatology

Geology

6031	Introductory Sedimentology and Stratigraphy
4164	Deltaic Geology
6062	Introductory Geophysics
6082	Introductory Geochemistry
7115	Paleoecology
7132	Dynamics of Sedimentation
7133	Sedimentary Petrology of Carbonates
7134	Clay Mineralogy
7181	Oceanographic Geochemistry
7183	Low-Temperature Physical Geochemistry
7981	Seminar in Geochemistry

DEPARTMENT OF HOME ECONOMICS

4010	Human Nutrition

DEPARTMENT OF MICROBIOLOGY

4161	Microbiology of Water, Sewage and Industrial Wastes
7020	Electron Microscopy of Biological Materials
7021	Virology

NUCLEAR SCIENCE CENTER

4101	Tracer Methodology for Biological Sciences
7101	Advanced Tracer Methodology for Biological Sciences

DEPARTMENT OF ZOOLOGY AND PHYSIOLOGY

4145	Ichthyology
4153	Animal Ecology
4647	Marine Vertebrate Zoology
4671	Marine Invertebrate Zoology, Part I
4672	Marine Invertebrate Zoology, Part II
7936	Seminar in Ecology
7937	Seminar in Ecology
7938	Seminar in Systematics, Evolution and Zoogeography
7939	Seminar in Systematics, Evolution and Zoogeography

The faculty for instruction and research for the courses in marine-related subjects are:

DEPARTMENT OF MARINE SCIENCES

Bahr, Leonard M., Jr., Ph.D., Associate Professor
Coleman, James M., Ph.D., Professor
Day, John W., Jr., Ph.D., Associate Professor
Ford, Ted B., Ph.D., Professor
Gagliano, S.M., Ph.D., Associate Professor Part-time
Gambrell, R., Ph.D., Associate Professor
Gosselink, James G., Ph.D., Chairman and Professor
Hsu, Shih-Ang, Ph.D., Professor
Knight, H. Gary, J.D., Campanile Charities Professor of Marine Resources Law
McIntire, William G., Ph.D., Professor
Patrick, William H., Jr., Ph.D., Boyd Professor
Roberts, Harry H., Ph.D., Professor
Rouse, L.J., Jr., Ph.D., Associate Professor
Schweitzer, James P., Ed.D., Associate Professor
Stone, James H., Ph.D., Professor
Turner, R. Eugene, Ph.D., Associate Professor
Van Lopik, Jack R., Ph.D., Professor
Whelan, Thomas III, Ph.D., Associate Professor Part-time
Wiseman, William J., Jr., Ph.D., Associate Professor

DEPARTMENT OF BIOCHEMISTRY

Allen, R.,Scott, Ph.D., Head and Professor

DEPARTMENT OF CHEMICAL ENGINEERING

Pike, Ralph W., Ph.D., Professor
Wilkins, Bert, Ph.D., Professor

DEPARTMENT OF CIVIL ENGINEERING

Suhayda, Joseph N., Ph.D., Associate Professor

DEPARTMENT OF FOOD SCIENCE

Grodner, Robert M., Ph.D., Professor
Luizzo, Joseph A., Ph.D., Professor
Meyers, Samuel P., Ph.D., Professor
Rao, Ramachandra M.R., Ph.D., Associate Professor

SCHOOL OF FORESTRY AND WILDLIFE MANAGEMENT

Avault, James W., Ph.D., Professor, Fisheries
Bryan, Charles F., Ph.D., Leader, Cooperative Fisheries Unit (USDI)
Conner, John V., M.S., Assistant Professor, Fisheries
Culley, Dudley D., Ph.D., Associate Professor, Fisheries
Truesdale, Frank M., Ph.D., Assistant Professor, Fisheries

DEPARTMENT OF GEOGRAPHY AND ANTHROPOLOGY

Muller, Robert A., Ph.D., Professor
Walker, H.J., Ph.D., Boyd Professor
West, Robert, Ph.D., Boyd Professor

DEPARTMENT OF GEOLOGY

Ferrell, Ray E., Ph.D., Associate Professor
Hanor, Jeffrey S., Ph.D., Associate Professor
Moore, Clyde H., Ph.D., Associate Professor

SCHOOL OF LAW

Knight, H. Gary, J.D., Campanile Charities Professor of Marine Resources Law

DEPARTMENT OF MICROBIOLOGY

Amborski, Robert L., Ph.D., Associate Professor
Socolofsky, Marion D., Ph.D., Professor

DEPARTMENT OF ZOOLOGY AND PHYSIOLOGY

Corkum, Kenneth C., Ph.D., Chairman and Professor
Fitzsimons, J. Michael, Ph.D., Assistant Professor
Meier, Albert H., Ph.D., Professor
Stickle, William B., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. James G. Gosselink, Chairman
Department of Marine Sciences
Louisiana State University
Baton Rouge, Louisiana 70803

SCHOOL OF FORESTRY AND WILDLIFE MANAGEMENT

The School of Forestry and Wildlife Management has four laboratories on the L.S.U. campus available for marine and marine-related research in the field of fisheries. The School also has access to various facilities of the Louisiana Wildlife and Fisheries Commission. Most notable is the marine lab at Grand Terre, Louisiana and the Rockefeller Wildlife Refuge at Grand Chenier, Louisiana. At Grand Terre the facility has been used to study the effects of oil pollution on shrimp. At Rockefeller, cooperative research on mariculture is being conducted in some 60 ponds.

The School offers a Master of Science with a major in fisheries. Fishery courses available for the M.S. are listed below. Requirements for the M.S. degree include 30 semester hours of graduate work, including six semester hours of thesis research. There are no language requirements, and a minor is optional.

The following courses are offered in conjunction with the above program:

4020	Taxonomy and Ecology of Aquatic Plants	2
4021	Limnology	3
4022	Fundamentals of Fish Culture	3
4023	Ichthyology	3
7020	Fish Parasites and Diseases	2
7021	Fishery Research Techniques	2
7022	Water Pollution Biology	3
7023	Fisheries Hydrography	3
7024	Shellfisheries Biology	3
7025	Mariculture	3

The University also offers graduate programs in marine science and ocean law which are described in the appropriate sections of this publication.

The instructional staff for the courses listed above consists of the following university and unit personnel:

FISHERIES

Avault, James W., Jr., Ph.D., Professor
Conner, John V., M.S., Assistant Professor
Culley, Dudley D., Jr., Ph.D., Associate Professor
Truesdale, Frank M., Ph.D., Assistant Professor

COOPERATIVE FISHERIES UNIT

Bryan, Charles F., Ph.D., Unit Leader
Herke, William H., Ph.D., Assistant Unit Leader

To obtain further information, address inquiries to:

Leslie L. Glasgow, Assistant Director
School of Forestry and Wildlife Management
Louisiana State University
Baton Rouge, Louisiana 70803

LOUISIANA STATE UNIVERSITY SCHOOL OF LAW

The Louisiana State University Law School gives particular emphasis to teaching and research in coastal and marine resources law. The proximity of the state to the northern Gulf of Mexico region, where considerable marine resource activity occurs, encourages interest and expertise in these matters. LSU law professors, associates and students are active in offshore oil and gas issues, mineral and fishery resource management problems, wetlands and shorelands boundary issues, recreation and environmental protection problems, etc. Law School personnel work closely with other departments of the University concerned with coastal and marine resources issues, especially the Center for Wetlands Resources and the Department of Marine Sciences. An LL.M (Master of Laws) program with specialization in Marine Resources Law and policy has been authorized in the Law School, but not as yet implemented.

SCHOOL OF LAW

5411	Environmental Legal Problems	1-4
5412	Land Use Planning	1-4
5414	Marine Resources Law	1-4
5416	International Law	1-4
5803	Seminar in Coastal Zone Management	1-4

The University also offers graduate programs in Marine Sciences and Fisheries which are described in the appropriate sections of this publication.

The following staff for the courses listed above consists of the following:

SCHOOL OF LAW

Bockrath, Joseph T., Assistant Professor
Ellis, Frederick W., J.D., Professor, Law
Knight, H. Gary, J.D., Campanile Charities Professor, Marine Resources Law, Professor, Law and Marine Sciences

To obtain further information, address inquiries to:

Professor H. Gary Knight
L.S.U. Law Center
Baton Rouge, Louisiana 70803

MARINE ENVIRONMENTAL SCIENCES CONSORTIUM OF ALABAMA
DAUPHIN ISLAND SEA LAB
Dauphin Island, Alabama 36528

The Marine Environmental Sciences Consortium is located at the Dauphin Island Sea Lab adjacent to Mobile Inlet. The Consortium has a membership of 19 Alabama four-year colleges and universities including: Alabama State University, Montgomery; Auburn University, Auburn; Birmingham-Southern College, Birmingham; Huntingdon College, Montgomery; Jacksonville State University, Jacksonville; Livingston University, Livingston; Mobile College, Mobile; Samford University, Birmingham; Spring Hill College, Mobile; Talladega College, Talladega; Troy State University, Troy; Tuskegee Institute, Tuskegee; The University of Alabama, University; The University of Alabama in Birmingham, University Station; The University of Alabama in Huntsville, Huntsville; University of Montevallo, Montevallo, University of North Alabama, Florence; Auburn University, Montgomery; and University of South Alabama, Modile.

Total facilities available include the Dauphin Island Sea Lab, the Point Aux Pins Marsh Lab at Point Aux Pins, three marine research vessels and several skiffs.

The Dauphin Island Sea Lab, consists of 27 buildings on the east end of Dauphin Island. Among these is a large instructional building containing well-equipped research labs, classrooms and library, a combination administration-recreation building, two 84-person dormitories, a two-story efficiency apartment building, a cafeteria, support buildings, an oceanographic equipment building, 13 three-bedroom houses and a diver training pool.

The University of Alabama owns the 250-acre marsh lab, the vessel maintenance facility and three diesel-powered research vessels including the 65-foot R/V Rounsefell and several vessels in the 35- to 45-foot class. These facilities are made available as a part of the total MESC complex.

MESC is a public non-profit corporation chartered by the state legislature in 1971. It is not a degree-granting institution; one of its principal functions is to support its 19 degree-granting schools with necessary marine related course offerings to satisfy their degree programs. All 19 schools have at least a B.S. in Biology with emphasis in Marine Science. Those schools with graduate programs have marine science-related degrees through the Ph.D. in some cases.

During the past year, 115 students attended summer classes at the Sea Lab.

The following list of courses are presently offered at the Sea Lab. None of the courses are numbered since individual schools have their own numbering system.

Benthic Community Structure
Coastal Climatology
Estuarine Science
Marine Vertebrate Zoology
Marine Invertebrate Zoology
Marine Geology
Marine Biology
Marine Botany
Marine Technical Methods
Marine Zoogeography
Marsh Ecology
Marine Ecology
Oceanology of the Gulf of Mexico
Coastal Ornithology
Physiology of Marine Organisms
Introduction to Oceanography
Recent Marine Sedimentation
Research on Special Topics
Seminar

To obtain further information, address inquiries to:

George Crozier, Director
Marine Environmental Sciences Consortium
Dauphin Island Sea Lab
Dauphin Island, Alabama 36528

MAINE MARITIME ACADEMY
Castine, Maine 04421

The Maine Maritime Academy offers courses and programs which prepare students to become officers in the U.S. Merchant Marine. The two major fields of study are Nautical Science for future deck officers and Marine Engineering for future engineering officers. All students must register in one or the other of these two major fields. Those who complete the program of four years are awarded a B.S. degree and are eligible to sit for the licenses issued by the U.S. Coast Guard for Third Mates or Third Assistant Engineers.

Student body is limited to 600. The Academy operates a 14,000-ton training vessel, T/V State of Maine, which makes a two-month annual cruise in May and June taking the classes that have just completed their freshman and junior years. Those who complete their sophomore year spend two months training aboard ships of the U.S. Merchant Marine.

Minor areas of study are offered in Oceanography and Ocean Engineering. Supporting these programs are a 34-foot research boat, laboratory facilities, and various small craft and supporting waterfront facilities and shops.

The number of graduates receiving the B.S. degree in the last three years has ranged between 115 and 155.

The following courses are offered:

NAUTICAL SCIENCE PROFESSIONAL COURSES

Ns-1	Deck Indoctrination
Ns-2	Ship Structure
Ns-3	Deck Drawing
Ns-4	Stability
Ns-5, 6	Meteorology
Ns-7, 8	Cargo
Ns-10, 11, 12, 13	Seamanship

Ns-14	Rules and Regulations
Ns-16, 17, 18, 19	Rules of the Road
Ns-20, 21	Communications
Ns-22	Marlinspike
Ns-30-37	Navigation
Ns-40	Ship's Business and Industrial Relations
Ns-41	Tanker Operations
Ns-42	Towboat Operations

MARINE ENGINEERING PROFESSIONAL COURSES

Eg-1	Engineering Fundamentals
Eg-3	Engineering Graphics
Eg-4	Applied Hydraulics
Eg-5	Automation
Eg-6	Steam Engines (Reciprocating)
Eg-8	Engine Safety
Eg-10-12	Electrical Engineering
Eg-14-15	Steam Generators
Eg-17-19	Steam Propulsion
Eg-21-22	Engineering Lab
Eg-24-26	Machine Tool Operations
Eg-28-29	Nuclear Engineering
Eg-31-33	Diesel Engineering
Eg-34-35	Refrigeration and Air Conditioning
Eg-40	Ship's Business and Industrial Relations
Eg-42	Nuclear Plant Engineering
Eg-43	Technical Writing
Eg-44	Advanced Electricity
Eg-45	Ship's Operations

OCEANOGRAPHY COURSES

Oc- 1	Introduction to Oceanography
Oc-10	Physical and Geological Oceanography
Oc-11	Introduction to Biological and Marine Life Forms
Oc-12	Ocean Research Vehicles and Equipment
Oc-30	Ecology and Pollution
Oc-31	Ocean Research

OCEAN ENGINEERING COURSES

Oe-10	Ocean Engineering
Oe-11	Ocean Engineering Summer Laboratory

Courses in Engineering Science, include: Statics, Thermodynamics, Strength of Materials, Fluid Mechanics.

The programs listed are supported by appropriate courses in Mathematics, Physics, Chemistry, Shipping Economics, Admiralty Law, Computer Science, Transportation -- most of which are electives.

Programs leaders of the four programs listed are as follows:

NAUTICAL SCIENCE

Higgins, R.F., Commander, B.S., Associate Professor and Chairman of Department

MARINE ENGINEERING

Snow, John F., Lieutenant Commander, Associate Professor and Chairman of Department

OCEANOGRAPHY

Barlow, John, Ph.D., Professor of Oceanography and Chairman, Arts and Sciences Department

OCEAN ENGINEERING

Cox, Virgil G., M.Sc., Ocean Engineer, Associate Professor

To obtain further information, address inquiries to:

Lcdr. Leonard Tyler
Director of Admissions
Maine Maritime Academy
Castine, Maine 04421

THE MARINE SCIENCE CONSORTIUM, INC.

Wallops Island, Virginia 23337

PARTICIPATING INSTITUTIONS

The American University, Washington, D.C. 20016
Bloomsburg State College, Bloomsburg, PA 17815
California State College, California, PA 15419
The Catholic University of America, Washington, D.C. 20017
Catonsville Community College, Catonsville, MD 21228
Cheyney State College, Cheyney, PA 19319
East Stroudsburg State College, East Stroudsburg, PA 18301
Edinboro State College, Edinboro, PA 16412
Indiana University of Pennsylvania, Indiana, PA 17551
Kutztown State College, Kutztown, PA 19530
Millersville State College, Millersville, PA 17551
The Pennsylvania State University, University Park, PA 16802
Rochester Institute of Technology, Rochester, NY 146[illegible]
Shippensburg State College, Shippensburg, PA 17527
Slippery Rock State College, Slippery Rock, PA 16057
West Chester State College, West Chester, PA 19380
West Virginia University, Morgantown, WV 26506

Each of the participating institutions offers courses in oceanography, for which classroom facilities, laboratory space, library and computer support are available on the various campuses.

The Consortium operates a Fieldstation at Wallops Island Marine Science Center, Wallops Island, VA, where more than 200 participants can be accommodated.

The physical facilities at the center consists of lecture rooms, wet and dry laboratories, dormitories, cafeterias, docking spaces and auxiliary buildings.

Vessels owned and operated by the Consortium include: the R/V Delaware Bay, a 50-foot, low-magnetic ex-mine diving tender equipped with radar, Loran, CBR and VHF radios, several winches, and diving lockers; the Chincoteague Bay, a 40-foot flat-bottom monitor for use in shallow waters; the R/V Laughing Gull, a 28-foot shallow draught aluminum boat for estuarine and bay work.

Degrees are granted only through the participating institutions and include B.A. and B.S. in Biology, Geology, Geography, Earth Sciences, and M.A., M.S., M.Ed., and Ph.D. degrees.

The following three-credit courses are offered during five summer sessions of three weeks each. Students apply for admission and pay board, lodging and operations fee to the Consortium, after which they register and pay tuition to one of the participating institutions. Credits may also be transferred to other colleges and universities.

The following courses are offered:

UNDERGRADUATE COURSES

MS 110	Introduction to Oceanography
MS 211	Field Methods in Oceanography
MS 212	Navigation
MS 221	Marine Invertebrates
MS 241	Marine Biology
MS 250	Wetland Ecology
MS 260	Marine Ecology
MS 298A	Introduction to Mariculture
MS 298B	Behavior of Marine Organisms
MS 298C	Sailing and Seamanship
MS 298D	Art Workshop-Painting of the Coastal Area
MS 298E	The Mammals of Coastal Ecosystems
MS 298F	Coastal Vegetation
MS 298G	Tropical Invertebrates
MS 298H	Marine Wildlife Photography
MS 320	Marine Microbiology
MS 331	Chemical Oceanography
MS 342	Marine Botany
MS 343	Marine Ichthyology
MS 344	Anatomy of Marine Chordates
MS 345	Ornithology
MS 362	Marine Geology
MS 364	Physical Oceanography
MS 398	Developmental Biology of Marine Organisms
MS 420	Marine Micropaleontology
MS 431	Ecology of Marine Plankton
MS 450	Coastal Geomorphology
MS 457	Marine Geophysics
MS 458	Exploration Methods in Marine Geology

GRADUATE COURSES

MS 500	Problems in Marine Science
MS 510	Oceanography (In-Service Teachers)
MS 530	Coastal Sedimentation
MS 540	Environmental Science Education
MS 555	Ocean Resources
MS 570	Marine Biology Cruise

For information on three-day pre-college oceanography programs, summer institutes and workshops, research cruises, etc., please contact the Marine Science Consortium.

Faculty members teaching at the Consortium include:

BIOLOGICAL OCEANOGRAPHY

Archibald, P.A., Ph.D., Slippery Rock State College
Banta, W.C., Ph.D., The American University
Bursey, C.R., Ph.D., Pennsylvania State University
Champ, M.A., Ph.D., The American University
Ha, S., Ph.D., Millersville State College
Haase, L., Ph.D., East Stroudsburg State College
Hays, H.E., Ph.D., Shippensburg State College
Henderson, A., D.Ed., Millersville State College
Howard, F.O., Ph.D., Shippensburg State College
Humpreys, J.G., Ph.D., Indiana University of Pennsylvania
Jones, H.G., M.S., West Chester State College
Liegey, F.W., Ph.D., Indiana University of Pennsylvania
Loeb, M., Ph.D., The American University
Marshall, J.A., Ph.D., West Virginia University
Ostrovsky, D., Ph.D., Millersville State College
Radinovsky, S., Ph.D., Millersville State College
Rhodes, S., M.S., Bloomsburg State College
Taylor, R., Ph.D., Slippery Rock State College
Zegers, D., Ph.D., Millersville State College

PHYSICAL OCEANOGRAPHY

Caravello-Hibbert, S., M.S., Catonsville Community College
DeSouza, L., Ph.D., Millersville State College
Drexler, W., Ed.D., Shippensburg State College
Ehleiter, J.E., Jr., M.A., West Chester State College
Gilheany, John J., Ph.D., The Catholic University of America
Hinds, R.W., Ph.D., Slippery Rock State College
Hunt, J.B., Ph.D., The Catholic University of America
Rowell, B.F., Ph.D., Kutztown State College
Sayre, W.G., Ph.D., Slippery Rock State College
Scharnberger, C.K., Ph.D., Millersville State College
Skeens, J.M., M.S., Catonsville Community College
Ward, N.A., Ph.D., Slippery Rock State College
Wegweiser, A.E., Ph.D., Edinboro State College

ENVIRONMENTAL SCIENCE EDUCATION

Chinnis, R.J., Ed.D., The American University

PRE-COLLEGE OCEANOGRAPHY PROGRAM

Anderson, B.N., B.S., Marine Science Consortium
Bonner, E., B.S., Marine Science Consortium
Cordry, G., B.S., Marine Science Consortium
Grimes, E., B.S., Marine Science Consortium
Koehler, J., B.S., Marine Science Consortium
Zimmerman, K., B.S., Marine Science Consortium

To obtain further information, address inquiries to:

Dr. K. Turgeon
The Marine Science Consortium, Inc.
P. O. Box 16
Wallops Island, Virginia 23337
(804) 824-5636

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Cambridge, Massachusetts 02139

Over the past two decades the Massachusetts Institute of Technology has developed a wide range of facilities for basic and applied research related to the development of new oceanic knowledge and to the utilization of the oceans to meet societal needs. In addition to the facilities in basic and engineering research in the various departments of the institute, the facilities of the Draper Laboratory as well as those of the Woods Hole Oceanographic Institution (WHOI) (available to MIT through the joint MIT/WHOI Programs in both oceanographic engineering and in oceanography), the following special marine-oriented facilities are available at the MIT campus: variable pressure water tunnel, ship model towing tank, acoustics and vibration laboratory, ship design laboratory, research vessel Edgerton, pressure testing facility, marine data systems laboratory, marine structural dynamics laboratory, a stroboscopic light laboratory and the water resources and hydrodynamics laboratory containing over 30,000 square feet devoted to teaching and research and including such facilities as a 100-foot wave channel, various channels for sediment studies, a coastal model basin, special flumes for variable density experiments, a special purpose digital computer for experimental control and data reduction, a special purpose analog computer for the analysis of random signals, plus instrumentation for the laboratory and field measurement of turbulence, wave profile and forces, entrained sediments, salinity, heat, dissolved oxygen, B.O.D., etc. Large scale digital computer facilities are available through the Engineering Departments and the M.I.T. Information Processing Center.

The Department of Ocean Engineering concentrates on "engineering for the ocean environment." It emphasizes the scientific background and those engineering sciences necessary to applications in the marine field, as well as engineering fundamentals and their application to a wide spectrum of engineering for modern ocean sciences, ocean exploration, ocean transportation, ship and naval engineering, and the utilization of ocean and coastal zone resources. A flexible curriculum, a departmental faculty with wide and continuing research and industrial experience, and close faculty-student contact all contribute to a sound and effective education.

The following two undergraduate degrees are offered in the Department of Ocean Engineering:

1. B.S. in Ocean Engineering. All undergraduate students are required to take 72 units in the academic area of humanities and social science. In addition, 12 units of biology or chemistry subject matter, 24 units of physics and 24 units of calculus are required. Each student must fulfill the requirement of satisfactorily completing 12 units of credit in a laboratory course. All of the foregoing requirements involve subjects outside the Department of Ocean Engineering. The departmental requirements include the following mandatory subjects: Marine Applied Mechanics, A Survey of Ocean Engineering, Applied Ocean Engineering, Differential Equations, Dynamics, and Linear Systems and Probability.

Also 70 units of unrestricted electives plus at least 72 units of planned electives are required. At least one planned elective subject must be selected in four out of these nine areas: acoustics, design, hydrodynamics, instrumentation, materials and fabrication, ocean environment, power and propulsion, probability and structures. Degrees awarded in 1979: eight.

2. B.S. in Naval Architecture and Marine Engineering. Requirements are the same as for the B.S. in Ocean Engineering except that out of the 72 units of planned electives at least one subject must be selected in each of the following areas: design, hydrodynamics, materials and fabrication, power and propulsion and structures. Degrees awarded in 1979: seven.

The following graduate degrees are offered by the Department of Ocean Engineering:

3. M.S. in Naval Architecture and Marine Engineering. Degrees awarded in 1979: 10.

4. M.S. in Ocean Engineering. Degrees awarded in 1979: five.

5. M.S. in Shipping and Shipbuilding Management. Degrees awarded in 1979: five.

6. M.S. without specification. Degrees awarded in 1979: two.

Preparation for these graduate degree programs usually includes an undergraduate degree in a field of engineering. Students with a background in physics, mathematics or chemistry may also be accepted with the proviso that they complete background areas in which they are deficient. For students who lack the complete range of background requirements the department is prepared to consider the M.S. degree without specification.

7. Ocean Engineer. The objective of a program leading to an engineer degree is a more advanced level and a broader range of competence in engineering and science than that required for the master's degree, but with less emphasis on creative research than that characterizing a doctoral program. In general terms, the master's degree requires a minimum of one academic year and the engineer degree without a concurrent M.S. degree requires two academic years beyond a baccalaureate in the same field.

The requirements for an engineer degree are the satisfactory completion of a program of advanced study and research approved by the department. The minimum program consists of at least 162 subject units and the completion of an acceptable thesis. A department may accept a master's thesis of superior quality for the engineer degree.

A program for an engineer degree ordinarily includes two subjects in the area of economics, industrial management, or political science, and at least 12 units of comprehensive design, such as Design of a Waterborne Vehicle or the equivalent. Degrees awarded in 1979: 25.

8. Doctor of Science. Degrees awarded in 1979: two.

9. Doctor of Philosophy. Degrees awarded in 1979: five.

The basic requirements for a doctorate degree are: completion of a program of advanced study, including a two-part general examination, and completion and oral defense of a thesis on original research.

The program of advanced study and research may be selected in any field approved by the department. The thesis is in this same field. The program often comprises subject areas reaching into several departments. If the field requires substantial participation by two or more departments, an interdepartmental faculty committee may be appointed by the dean of the Graduate School to advise with a graduate registration officer in the administration of the student's program.

Candidates for a doctorate are no longer required to demonstrate a proficiency in foreign languages.

The Department of Ocean Engineering also offers a joint program in oceanographic engineering with the Woods Hole Oceanographic Institution leading to the degrees of Ocean Engineer, Ph.D., or Sc.D. awarded jointly by the two institutions. Students in this program choose to specialize in those areas of oceanographic engineering related to advancements in marine geophysics, geology, oceanography, or oceanographic instrumentation. Requirements for the joint degrees are similar to those of the corresponding degree awarded by the department above.

The Department of Civil Engineering also offers marine-related graduate degree programs in civil engineering. The focus of these programs is on coastal problems of the marine environment and on constructed marine facilities.

Preparation for these programs of graduate study usually includes an undergraduate degree in civil, mechanical or electrical engineering or oceanography; but, recognizing the possible need for some additional work, students with a background in physics, mathematics, chemistry, and biology may also be accepted. The degrees offered, and their requirements are as follows:

1. M.S. in Civil Engineering. This requires completion of an approved program of at least 66 subject units, of which 42 units must be in "A" subjects, and the completion of an acceptable thesis. Degrees awarded in 1979: 62.

2. M.S. This "unspecified" degree is awarded in cases in which at least 34 units of "A" subjects plus the thesis are not from within the Department of Civil Engineering. This provides one mechanism for pursuing interdepartmental fields of interest. Degrees awarded in 1979: four.

3. Civil Engineer. The "professional" degree, Civil Engineer, is awarded for completion of a program at a more advanced level and over a broader range than that for the master's degree but with less emphasis on creative research than that characterizing a doctoral program. The program content is worked out by the student in consultation with his faculty advisor but must contain at least 162 subject units plus an acceptable thesis. Degrees awarded in 1979: 25.

4. Sc.D. or Ph.D. in Civil Engineering. The basic requirements for the doctorate are: completion of a program of advanced study, including a general examination consisting of a written and an oral portion; and completion and oral defense of a thesis based on original research. Degrees awarded in 1979: 25.

The total doctoral program must include at least 150 units of graduate subject units up to half of which may be specified by the graduate committee in charge of the candidate's major area of specialization. It is for this core material that the candidate is responsible on the general examination. Doctoral candidates are no longer required to demonstrate a proficiency in foreign languages.

The following courses are offered in conjunction with the programs of several departments in the School of Engineering. Each department listed participates with WHOI in the joint program in oceanographic engineering.

SCHOOL OF ENGINEERING

Department of Civil Engineering

UNDERGRADUATE COURSES

1.071	Analysis of Uncertainty	9
1.61J	Structures and Strategies of Ecosystems	12

GRADUATE COURSES

1.142	Numerical Methods of Engineering Analysis (A)	9
1.143	Mathematical Optimization Techniques I(A)	9
1.146	Engineering Systems Analysis (A)	9
1.148	Decision Theories and Social Realities in Engineering and Planning (A)	9
1.151	Computer Approaches to Engineering Problems	9
1.154	Simulation Methods (A)	9
1.16J	Special Studies in Systems Engineering (A)	12
1.161J	Modelling and Analysis of Systems Pertaining to National Development (A)	12
1.162	Analytic Formulation of Engineering System Problems (A)	9
1.175	Analysis of Public Systems (A)	9
1.83	Applications of Multivariate Statistical Analysis (A)	9
1.184	Applied Random Processes (A)	9
1.56	Advanced Structural Mechanics (A)	9
1.582	Structural Reliability (A)	9
1.584	Analysis and Design of Shell Structures (A)	9
1.586	Structural Dynamics (A)	9
1.631	Advanced Hydromechanics I(A)	9
1.632	Advanced Hydromechanics II(A)	9
1.681	Experimental Hydromechanics (A)	6
1.69	Waves and Coastal Processes (A)	9
1.70	Mechanics of Sediment Transport (A)	6
1.77	Water Quality Control (A)	8

Department of Ocean Engineering

UNDERGRADUATE COURSES

13.001	Introduction to Marine Applied Mechanics	12
13.002	Marine Applied Mechanics	12

13.003J	Dynamics	12
13.004	Linear Systems and Random Processes in Ocean Engineering	12
13.011	Hydrostatics	4
13.013J	Water, Air and Interface Vehicles	12
13.014	The Oceans	12
13.10J	Introduction to Structural Mechanics	10
13.25J	Thermodynamics of Power Systems	12
13.49	Dynamics of Physical and Social Systems	12
13.51	Computer Models of Physical and Engineering Systems I	12
13.52	Management in Engineering	12
13.700-709	Special Problems in Ocean Engineering	Arranged
13.73	A Survey of Ocean Engineering	3
13.771	Engineering Internship	6
13.772	Industrial Practice in Ocean Engineering	Arranged
13.79	Applied Ocean Engineering	12
13.901	Ocean Engineering Laboratory I	6
13.902	Ocean Engineering Laboratory II	6
13.97	Introduction to Technology and Law	12

GRADUATE COURSES

13.012	Applied Hydrostatics	10
13.021	Marine Hydrodynamics I(A)	12
13.022	Marine Hydrodynamics II(A)	12
13.03	Advanced Hydromechanics of Ship Design (A)	9
13.04	Hydrofoils and Propellers (A)	12
13.05	Boundary Layers (A)	12
13.07	Free Surface Hydrodynamics (A)	9
13.08	Stability and Motion Control of Ocean Vehicles (A)	9
13.09	Potential Flows (A)	9
13.111	Structural Mechanics (A)	12
13.112J	Analysis and Design of Offshore Structures (A)	9
13.121	Ship Structures (A)	9
13.122	Ship Structural Design (A)	6
13.123	Advanced Analysis and Design of Ocean Engineering Structures (A)	9
13.131	Plastic Analysis of Structures (A)	9
13.132	Advanced Structural Topics (A)	9
13.14J	Structural Mechanics in Nuclear Power Technology (A)	12
13.15J	Materials for Ocean Engineering	11
13.16J	Fracture of Structural Materials (A)	9
13.17J	Welding Engineering (A)	9
13.21	Ship Power and Propulsion (A)	12
13.26J	Thermal Power Systems (A)	12
13.27	Ocean Engineering Power Systems (A)	6
13.39	Analysis of Techniques for Fabricating Structures (A)	6
13.411	Principles of Naval Ship Design (A)	12
13.412	Principles of Ship Design (A)	12
13.431	Methods of Naval Ship-System Design (A)	9
13.451	Projects in Naval Ships Conversion Design (A)	Arranged
13.461	Projects in New Construction Naval Ship Design (A)	Arranged
13.462	Projects in Ocean Engineering Systems Design (A)	Arranged
13.48	Offshore Engineering Design (A)	12
13.50	Computer Applications to Marine Problems	10
13.61	Network, Scheduling, Routing and Planning (A)	9
13.62J	Engineering Systems Analysis (A)	9
13.63	Reliability, Availability and Maintainability of Systems (A)	9
13.631	Port Planning and Development (A)	12
13.65	Production Analysis (A)	9
13.66	Marine Transportation Economics (A)	9
13.67	Marine Decision-Making Under Uncertainty (A)	9
13.68	Management of Marine Systems (A)	9
13.681J	Issues in Transportation Management (A)	9
13.69	International Shipping (A)	9
13.710-719	Special Problems in Ocean Engineering	Arranged
13.74J	Marine Data Systems (A)	12
13.76	Introduction to Random Processes in Ocean Engineering (A)	12
13.77J	Invention	9
13.774	Advanced Engineering Internship	6
13.78	Entrepreneurship	9
13.80J	Mechanical Vibration	12
13.81J	Principles of Acoustics (A)	12
13.85	Fundamentals of Underwater Sound Applications (A)	9
13.86	Ocean and Seabed Acoustics (A)	12
13.903	Advanced Ocean Engineering Laboratory (A)	6
13.92	Public Policy and Use of the Sea (A)	9
13.94J	Ocean Engineering and Law Seminar (A)	9
13.961J	Resources Management (A)	9
13.962	Legal Aspects of Ocean Resources and Systems Management (A)	9
13.98J	Coastal Zone Management (A)	9
13.990J	Oceanographic Systems I	12
13.991J	Oceanographic Systems II	12
13.992	Marine Navigation, Positioning and Data Telemetry (A)	12
13.994	Buoy Engineering	6
13.997	Principles of Oceanographic Instrument Systems I - Measurement Platforms (A)	9
13.998	Principles of Oceanographic Instrument Systems II - Sensors and Measurements (A)	12
13.999J	Special Projects in Oceanographic Engineering (A)	Arranged

Department of Materials Science and Engineering

UNDERGRADUATE COURSES

3.701J	Materials for Ocean Engineering	11

GRADUATE COURSES

3.36J	Welding Engineering (A)	9
3.54	Corrosion (A)	8

Department of Mechanical Engineering

UNDERGRADUATE COURSES

2.131J	Environmental Ecology I	9
2.132J	Environmental Ecology II	9
2.41J	Thermodynamics of Power Systems	12
2.412	Heat Engineering	12
2.54	Heat Transfer	6

GRADUATE COURSES

2.032	Advanced Mechanics (A)	12
2.083	Applied Elasticity (A)	12
2.25	Advanced Fluid Mechanics (A)	12
2.271	Compressible Fluid Mechanics (A)	12
2.275	Turbomachinery Design	12
2.284	Desalination and Water Purification (A)	12

2.451	Intermediate Thermodynamics (A)	12
2.452	Advanced Thermodynamics (A)	12
2.55	Advanced Heat Transfer (A)	12
2.601J	Thermal Power Systems (A)	12
2.621	Gas Turbines (A)	12

Department of Electrical Engineering and Computer Science

GRADUATE COURSES

6.432	Stochastic Processes and Applications (A)	12
6.452	Stochastic Filtering and Detection (A)	12
6.455J	Marine Data Systems (A)	12

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF CIVIL ENGINEERING

Christian, John T., Ph.D., Associate Professor
Connor, Jerome, J., Jr., Sc.D., Professor
Cornell, C. Allin, Ph.D., Associate Professor
de Neufville, Richard L., Ph.D., Associate Professor
Gelhar, Lynn W., Ph.D., Associate Professor
Harleman, Donald R.F., Sc.D., Professor
Ippen, Arthur T., Ph.D., Institute Professor
Manheim, M.L., Ph.D., Professor
Marks, David H., Ph.D., Associate Professor
Mei, Chiang C., Ph.D., Associate Professor
Perkins, Frank E., Sc.D., Associate Professor
Roessit, J.M.V., Sc.D., Associate Professor
Roos, D., Ph.D., Associate Professor
Sussman, J.M., Ph.D., Associate Professor
Vanmarcke, E.H., Ph.D., Assistant Professor

DEPARTMENT OF OCEAN ENGINEERING

Abkowitz, M.A., Ph.D., Professor of Ocean Engineering
Baggeroer, A.B., Sc.D., Associate Professor of Ocean Engineering and Electrical Engineering
Burke, D.V., Jr., Ph.D., Associate Professor of Ocean Engineering
Carmichael, A.D., Ph.D., Professor of Power Engineering
Chryssostomidis, D., Ph.D., Associate Professor of Naval Architecture
Dyer, Ira, Ph.D., Head of Department, Professor of Ocean Engineering
Frankel, E.G. Marine Mechanical Engineer, Professor of Marine Systems
Kerwin, J.E., Ph.D., Professor of Naval Architecture
Kildow, J.T., Ph.D., Associate Professor of Ocean Policy
Leehey, P., Ph.D., Professor of Applied Mechanics
Marcus, H.S., D.B.A., Associate Professor of Marine Systems
Masubuchi, K., D.Eng., Professor of Ocean Engineering
Milgram, J.H., Ph.D., Professor of Naval Architecture
Newman, J.N., Sc.D., Professor of Naval Architecture
Noblesse, F., Ph.D., Assistant Professor of Ocean Engineering
Nyhart, J.D., J.D., Associate Professor of Ocean Engineering and Management
Gomes de Oliveira, J.M., Ph.D., Assistant Professor of Ocean Engineering
Psaraftis, H.N., Ph.D., Assistant Professor of Marine Systems
Sweeney, J.H., III, Nav.E., Professor of Naval Architecture, Professor of Naval Science (Visiting), Director, Office of Naval Science
Triantafyllou, M.S., Sc.D., Assistant Professor of Ocean Engineering
Vandiver, J.K., Ph.D., Associate Professor of Ocean Engineering
VanHouten, R.J., Ph.D., Assistant Professor of Ocean Engineering
Xirouchakis, P.C., Ph.D., Assistant Professor of Ocean Engineering
Yeung, R.W., Ph.D., Associate Professor of Naval Architecture

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

Clark, J.P., Sc.D., Assistant Professor of Materials System
King, T.B., Ph.D., Professor
Masubuchi, K., D.Eng., Professor of Materials Science and Ocean Engineering

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Baggeroer, A.B., Sc. D., Associate Professor of Electrical Engineering and Ocean Engineering
Edgerton, H.E., Sc. D., Professor of Electrical Measurements, Emeritus
McClellan, J.H., Ph.D., Associate Professor of Electrical Engineering
Oppenheim, A.V., Sc.D., Professor of Electrical Engineering

DEPARTMENT OF MECHANICAL ENGINEERING

Crandell, S.H., Ph.D., Professor of Mechanical Engineering
Hatsopoulos, G.N., Sc.D., Senior Lecturer of Thermodynamics
Heywood, J.B., Ph.D., Associate Professor of Mechanical Engineering
Lardner, T.J., Ph.D., Associate Professor of Mechanical Engineering
Probstein, R.F., Ph.D., Professor of Mechanical Engineering
Rohsenow, W.M., D.Eng., Professor of Mechanical Engineering
Smith, J.L., Sc.D., Professor of Mechanical Engineering
Sonin, A.A., Ph.D., Associate Professor of Mechanical Engineering
Stickney, R.E., Ph.D., Professor of Mechanical Engineering
Wilson, D.G., Ph.D., Associate Professor of Mechanical Engineering

To obtain further information, address inquiries to any of the departments:

M.I.T.
Cambridge, Massachusetts 02139

The graduate program in oceanography is conducted jointly by M.I.T. and the Woods Hole Oceanographic Institution. Three departments in the School of Science at M.I.T. -- those of Earth and Planetary Sciences, Meteorology and Biology -- are involved in instruction in physical oceanography, marine geology, marine geophysics, marine chemistry and geochemistry, and biological oceanography. Each student has a primary affiliation with one of the three departments.

M.I.T. provides instruction in many fields of science, engineering and the humanities, as well as laboratories, libraries, and computer and data processing services; additionally, a small research boat which is used for local observations and for instrument testing is docked at the M.I.T. facility at Lewis Wharf in Boston. W.H.O.I. brings to the program a large scientific staff involved in many phases of oceanography, along with extensive laboratory facilities on shore and a fleet of seagoing ships devoted to research and instruction. Students may take courses simultaneously at both institutions, and transportation between the two campuses is provided. Thesis research may be undertaken at either institute, the locations of the thesis advisor and the needed facilities usually being the determining factors.

All M.I.T. doctoral candidates in oceanography are considered to be in the joint program and are awarded a joint degree of Ph.D. or Sc.D. in Oceanography. (No distinction is made between the two and a student may choose whichever seems more appropriate to him.) In the first phase of the doctoral program, the student prepares himself for the general examination in the field of his degree; after successfully passing this, he enters the second phase, that of thesis research. The successful defense of a thesis of high quality marks the completion of the program. There were three Ph.D.'s awarded between June 1978 and February 1979.

The degree of Master of Science is awarded only by M.I.T. Minimum requirements are the completion of an approved program of 66 units, of which at least 42 must be graduate "A" subjects and the presentation of an acceptable thesis. There was one S.M. awarded between June 1978 and February 1979.

All applicants to the graduate program should have a strong background in basic mathematics and physics; chemistry is required for students of marine chemistry and biological oceanography while geology is needed for marine geology.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

12.20J	Environmental Chemistry of the Ocean-Atmosphere System	12
12.21	Physics of the Ocean	12

GRADUATE COURSES

12.32	Mechanics of Sedimentary Processes	12
12.56	Advanced Seminar in Plate Tectonics	9
12.72	Oceanic Petrology	9
12.73	Introduction to Marine Geology	12
12.74	Marine Micropaleontology	9
12.75	Marine Sediments	12
12.752	Paleomagnetism	9
12.77	Marine Geophysical Data Interpretation	11
12.774	Plants, Animals, and Sediments	Arranged
12.80	Marine Chemistry	14
12.81	Waves and Tides	12
12.82	Marine Geochemistry of Sediments	12
12.83	Marine Geochemistry	12
12.84	Organic Geochemistry	9
12.85	Oceanographic Time Series	9
12.86	General Circulation of the Oceans	9
12.87	Equatorial Physical Oceanography	9

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF EARTH AND PLANETARY SCIENCES

Atwater, Tanya M., Ph.D., Associate Professor of Marine Geology
Boyle, Edward A., Ph.D., Assistant Professor of Chemical Oceanography
Edmond, John M., Ph.D., Associate Professor of Chemical Oceanography
Eriksen, Charles C., Ph.D., Assistant Professor of Physical Oceanography
Sclater, John G., Ph.D., Professor of Marine Geophysics
Southard, John B., Ph.D., Associate Professor of Geology
Wunsch, Carl I., Ph.D., Cecil and Ida Green Professor of Physical Oceanography and Head of the Department

DEPARTMENT OF METEOROLOGY

Cane, Mark A., Ph.D., Assistant Professor of Oceanography
Charney, Jule G., Ph.D., Sc.D., Alfred P. Sloan Professor of Meteorology
Mollo-Christensen, Erik, Sc.D., Professor of Oceanography
Flierl, Glenn R., Ph.D., Assistant Professor of Oceanography

DEPARTMENT OF BIOLOGY

Holt, Charles E., III, Ph.D., Associate Professor of Biology
Luria, Salvador E., M.D., D.Sc., Institute Professor of Biology
Magasanik, Boris, Ph.D., Head of Department and Professor of Microbiology
Rich, Alexander, M.D., Professor of Biophysics

To obtain further information, address inquiries to:

Joint Program in Oceanography
Massachusetts Institute of Technology
Room 54-912
Cambridge, Massachusetts 02139

or,

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

MASSACHUSETTS MARITIME ACADEMY

Buzzards Bay, Massachusetts 02532

The Massachusetts Maritime Academy offers an accredited, four year degree program to undergraduates preparing them for licensed service in the U.S. Merchant Marine. The Academy also offers a summer program of courses in the marine sciences to other interested students. The four year program includes three summers of practical training on board the Academy's 480-foot training ship Bay State. The summer program is supported by several power boats used to conduct field trips in the adjacent waters of the Cape Cod Canal, Buzzards Bay and Cape Cod Bay. The physical facilities of the Academy include a classroom building; administrative offices; laboratories in the physical sciences, engineering, and marine sciences; dormitories accommodating 800 students, a library of 50,000 volumes, gymnasium, dining hall and a computer center with seven terminals tied into a central computer servicing the Massachusetts State College System.

The following degrees are offered:

1. B.S. in Marine Transportation leading to a Third Mate License.

Humanities	9
Social Sciences	14
Basic Sciences	26
Naval Science*	6
Marine Engineering Science	2
Nautical Science (Major)	63
Elective	11
Sea Terms (Three two-month cruises)	24
	155

Sixty-seven degrees granted June 1979.

2. B.S. in Marine Engineering leading to Third Assistant Engineer's License.

Humanities	9
Social Sciences	10
Basic Sciences	31
Naval Science*	6
Nautical Science	6
Marine Engineering Science (Major)	61
Electives	11
Sea Term (Three two-month cruises)	24
	158

One Hundred Twenty-three degrees granted June 1979.

UNDERGRADUATE COURSES

Marine Transportation	611	Basic Seamanship	4
Advanced Seamanship	621	Advanced Seamanship	4
Meteorology	622	Meteorology	3
Navig. I	623	Nautical Astronomy	4
Navig. II	631	Celestial Navigation	4
Navig. III	633	Celestial Navigation	4
Navig. IV	642	Celestial Navigation	4
RuRd I	632	Inland and Pilots Rules of the Road	3
RuRd II	643	International Rules of the Road	3
Cargo I	634	Ship's Cargo Handling	4
Cargo II	641	Ship's Cargo Handling	4
Naval Architecture I	635	Ship Construction	3
Naval Architecture II	644	Stability and Trim	3
MarEng I	711	Introduction to Marine Engineering	2
Steam I	721	Marine Boilers	3
Steam II	722	Marine Auxiliaries	4
Steam III	723	Marine Turbines	3
Electr. I	731	Marine Electrical Engineering	4
Electr. II	732	Marine Electrical Engineering	4
Diesel I	735	Marine Diesel Engineering	4
Diesel II	743	Marine Diesel Engineering	4
Oceanog. I	223	Introduction to Oceanography	2
Oceanog. II	2301	Physical and Chemical Oceanography	3
Oceanog. III	2302	Geological and Biological Oceanog.	3
OcEng I	7741	Marine Hydrodynamics	3
OcEng II	7742	Ocean Engineering Structures	3
OcEng IV	7751	Marine Resources	3
OcEng V	7752	Ocean Engineering Instrumentation and Research	2
Fish I	6631	Commercial Fisheries Techniques	3
Fish II	6632	Fisheries Ecology	3
Fish III	6641	Ichthyology	3
Fish IV	6642	Fisheries Research	2

SUMMER MARINE SCIENCES COURSES

Marine Science	050	Introduction to Marine Science	None
Marine Science	155	Scuba Diving	1 or None
Marine Science	445	Marine Invertebrates	3
Marine Science	446	Marine Botany	3
Marine Science	447	Ichthyology	3
Marine Science	448	Marine Biology	3
Marine Science	450	Oceanography for Science Teachers	3
Marine Science	453	Man and the Coastal Environment	3
Marine Science	483	Natural History of Cape Cod	3

The instructional staff for the courses listed above include the following:

OCEANOGRAPHY

Kan, David E., Ph.D., Assistant Professor

FISHERIES SCIENCE

Sabo, Dennis, Ph.D., Assistant Professor

OCEAN ENGINEERING

Huguenin, John E., O.E., Associate Professor

MARINE ENGINEERING

Robideau, Robert, Ph.D., Associate Professor
Walsh, Myles, Ph.D., Professor

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* Qualification for Naval Research Commission

MARINE TRANSPORTATION

Matheson, David, B.S., Associate Professor
Northern, H. Clifton, M.S., Associate Professor

To obtain further information, address inquiries to:

Academic Dean
Massachusetts Maritime Academy
Buzzards Bay, Massachusetts 02532

McGILL UNIVERSITY
Montreal, Quebec, Canada

The Marine Sciences Centre of McGill University is situated at 772 Sherbrooke Street West in Montreal, opposite the main university campus.

Research at the Marine Sciences Centre is carried out in a broad diversity of marine environments, including the Arctic regions, the Gulf of St. Lawrence, the estuary of the St. Lawrence River and the Caribbean Sea. Participation in oceanographic cruises organized by the Bedford Institute at Dartmouth, Nova Scotia, or other government agencies, can be arranged. The Bellairs Research Institute of McGill University in Barbados, West Indies, which opened in 1954, is a research centre specializing in tropical marine ecology. It owns a 50-foot vessel and has potential for work in other aspects of the marine sciences.

Biological collections are available at the Redpath Museum of McGill University, with special laboratory facilities for the study of marine invertebrates. An up-to-date collection of publications in oceanography and related matters, as well as many journals in the marine fields, is kept in the library of the Marine Sciences Centre.

Masters and doctoral degrees are offered in the following subjects: marine biology, physical oceanography and marine geology. Graduate students are expected to take certain basic courses, including those considered necessary for their training and for the development of their particular fields of specialization. Primary emphasis for both the M.Sc. and Ph.D. degrees is placed upon research and thesis presentation. Ph.D. candidates are required to pass a comprehensive examination within two years of registering in the Marine Science Centre program; this examination covers the whole field of marine science but allows for the specialized interests and training of each student. Ph.D. candidates are also required to defend their theses at an oral examination.

The following courses are offered in the Marine Sciences Centre:

UNDERGRADUATE COURSES

BIOLOGICAL SCIENCES

177-441B	Biological Oceanography	3

PHYSICAL SCIENCES

198-309A	Descriptive Oceanography	3
198-319B	Dynamical Oceanography	3

GRADUATE COURSES

BIOLOGICAL SCIENCES

395-537B	Advanced Invertebrate Zoology	3
395-545A	Water Pollution: Biological Aspects	2
395-591D	Advanced Marine Ecology	2
395-639A	Tropical Marine Ecology	3
395-691D	Advanced Marine Ecology	6
395-692A	Estuaries	3

PHYSICAL SCIENCES

395-695A	Physics of the Ocean	3
395-696A	Seminar Course in Physical Oceanography	3

GEOLOGICAL SCIENCES

395-697B	Marine Geology and Geochemistry	3
395-721D	Sediments and Marine Geology	6

GENERAL

395-660D	Seminar in General Oceanography	-
395-698B	Topics in Oceanography	3

The full-time staff of the Marine Sciences Centre is as follows:

Dunbar, M.J., Ph.D., Professor
Goldstein, M.E., Ph.D., Associate Professor
Lalli, C.M., Ph.D., Associate Professor
Lewis, J.B., Ph.D., Professor (Director, Redpath Museum)
Mountjoy, E.W., Associate Member
Sander, F., Ph.D., Assistant Professor (Director, Bellairs Research Institute)

PHYSICS

Ingram, R.G., Ph.D., Assistant Professor
Langleben, M.P., Ph.D., Professor
Pounder, E.R., Ph.D., Professor (Vice-Chairman)
Reiswig, H.M., Associate Professor

GEOLOGICAL SCIENCES

d'Anglejan, B.F., Ph.D., Associate Professor (Chairman)
Hesse, R., Associate Member

To obtain further information, address inquiries to:

(Please see next page)

Professor B.F. d'Anglejan, Chairman
Marine Sciences Centre
McGill University
P. O. Box 6070
Montreal 101, PQ, Canada

MIAMI DADE COMMUNITY COLLEGE
Miami, Florida 33136

Miami Dade Community College has a marine technician training facility located on the Miami River approximately 3.5 miles from the Downtown Campus. In conjunction with the Marine Science Technology Department, students are eligible to take courses at North and South Campus respectively. All marine science courses must be taken at the Marine Science Facility.

The Marine Science Facility on the Miami River is a temporary site. Plans are underway to establish a building for the department on Virginia Key, Rickenbacker Causeway, Miami, Florida. The building will be within walking distance of the Atlantic Oceanographic and Meteorological Laboratory (NOAA); Rosenstiel School of Marine and Atmospheric Sciences (University of Miami); National Marine Fisheries Service and Palisades Geophysical Institute. The proposed building will be on a 3.1 acre tract of land and the construction of the new facility will begin in the Fall of 1979.

The department owns and operates a 46-foot research vessel, the R/V Martech, two 20-foot outboards -- the R/V Explorer and the R/V Observer. These vessels are used extensively for survey and field work in Biscayne Bay, the coral reefs located in the Florida Keys, as well as in the Gulf Stream off Miami. The R/V Martech is equipped with FM-VHF radiotelephone, MF-AM radiotelephone, Decca radar, Loran, Raytheon fathometer, Ross Bottom profiler, 7.5 Kw Onan generator, hydraulic winch and A-frame. It carries 400 gallons of diesel fuel and 200 gallons of fresh water. Cruising speed is 14 knots. This vessel is capable of light duty trawling, light hydraulic tool operation and as a hard-hat diving support vessel. The smaller 20-foot vessels act as support vessels.

The research equipment within the department consists of an STD (Salinity, Temperature and Depth) recording system, XBT (Expendable Bathythermograph), analog recorder with computer interface capabilities, proton magnetometer, submarine photometer, bongo nets, otter trawls, seine nets, microscopes, scuba equipment, KMB-9 band mask, Helle communications equipment, Aquadyne Air-Hat, Swindell Air-Hat, Nikonos II camera equipment, underwater 16 MM movie cameras, Sony video-recorder with underwater housing, hydraulic/pneumatic tools, underwater welding-cutting capabilities, metal fabrication shop (machine - welding), boat engine repair shop, fiberglass - plastics fabrication, spectrophotometer, centrifuge induction salinometer and electronic - instrumentation repair laboratory.

The following programs are offered:

MARINE ENGINEERING TECHNOLOGY (Associate in Science Degree, A.S.) Graduates 1975 - 12

First Term

OCE 101	Introduction to Oceanography	3
MAO 170	Introduction to Oceanography Lab	1
MAO 163	Marine Electricity	3
MAO 173	Marine Electricity Lab	1
APM 162	Technical Mathematics I	3
or		
MAT 121	College Algebra*	3
SSS 101	Social Science	3
ENG 120	English Composition	3
		17

Second Term

MAO 161	Applied Oceanography	3
MAO 162	Seamanship	2
MAO 172	Seamanship Lab	1
APM 163	Algebra and Trigonometry	3
or		
MAT 122	Trigonometry*	3
ENG 121	English	3
SSS 102	Social Science	3
PED 137	Sailing	
or		
HEN 210	First Aid	1-2
		16-17

Third Term

MAO 164	Marine Engineering Pract.	3
MAO 174	Marine Engineering Pract. Lab I	1
MAO 263	Ocean Measurements I	3
MAO 273	Ocean Measurements Lab	1
ASE 163	Physics with Application	3
ASE 174	Physics Lab	1
MAO 165	Operational Diving	2
MAO 175	Operational Diving Lab	3
		17

Fourth Term

MAO 180	Marine Engineering Pract. II	3
MAO 176	Marine Engineering Pract. Lab II	1
ASE 164	Physics with Application	3
ASE 175	Physics Lab	1
MAO 298	Internship or Field Problem	3
	Elective	3
	Elective	3
		17

Total credits for the program 67-68

MARINE SURVEY TECHNOLOGY (Associate in Science Degree A.S.) Graduates 1975 - 12

First Term

OCE 101	Introduction to Oceanography	3
MAO 170	Introduction to Oceanography Lab	1
MAO 163	Marine Electricity	3
MAO 173	Marine Electricity Lab	1
APM 162	Technical or Mathematics I	3
or		
MAT 121	College Algebra*	3

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* With permission of Department Chairman only.

ENG 120	English Composition	3
		14

Second Term

MAO 161	Applied Oceanography	3
MAO 162	Seamanship	2
MAO 172	Seamanship Lab	1
APM 163	Algebra and Trigonometry	3
or		
MAT 122	Trigonometry*	3
MAO 165	Operational Diving	2
MAO 175	Operational Diving Lab	3
HEN 210	First Aid	2
		16

Spring or Summer Term

ENG 121	English Composition	3

Third Term

MAO 263	Ocean Measurements I	3
MAO 273	Ocean Measurements Lab	2
MAO 164	Marine Engineering Pract. 1	3
MAO 174	Marine Engineering Pract. Lab	1
ASE 163	Physics with Application 1	3
ASE 174	Physics Lab	1
SSS 101	Social Science	3
MAO 275	Biological and Chemical Sampling Techniques	2
MAO 251	Biological and Chemical Sampling Techniques Lab	1
		19

Fourth Term

MAO 281	Ocean Measurements II	3
MAO 255	Ocean Measurements II Lab	1
ASE 164	Physics with Application II	3
ASE 175	Physics Lab	1
SSS 102	Social Science Elective	3
		14

Spring or Summer Term

MAO 298	Internship or Field Problem	3
Total credits for the program		68

MARINE SURVEY TECHNOLOGY (Associate in Science Degree A.S.) Graduates 1975 - 12

First Term

MAO 162	Seamanship	2
MAO 172	Seamanship	1
OCE 101	Introduction to Oceanography	3
MAO 170	Introduction to Oceanography Lab	1
ELS 160	D.C. Circuits	4
APM 162	Technical Math I	3
or		
MAT 121	College Algebra*	3
SSS 101	Social Science	3
		17

Second Term

MAO 161	Applied Oceanography	3
ELS 162	A.C. Circuits	4
APM 163	Algebra and Trigonometry	3
or		
MAT 122	Trigonometry*	3
ASE 163	Physics with Applications	3
ASE 174	Physics Lab	1
		14

Spring or Summer Term

ELS 180	Network Analysis	3
ENG 120	English Composition	3
		6

Third Term

MAO 164	Marine Engineering Pract. I	3
MAO 174	Marine Engineering Pract. Lab	1
MAO 263	Ocean Measurements I	3
MAO 273	Ocean Measurements Lab I	1
ELS 163	Semiconductor Fundamentals	4
ELS 165	Electronic Devices	4
		16

Fourth Term

ELS 281	Transistor Circuits	4
ELS 282	Pulse and Digital Cts.	4
ENG 121	English Composition	3
SSS 102	Social Science	3
HEN 210	First Aid	2
		16
Total credits for the program		69

A one-year Commercial Diving Certificate program will be initiated in the Fall of 1979.

The instructional staff for the courses listed above consists of the following:

- Frehsee, Eric, B.S., Diving Supervisor
- Moutvic, Joe, M.S., Assistant Professor
- Rodriguez, Carlos, A.S., Diving Technician/Instructor
- Zawodny, Joe, M.S., Assistant Professor

To obtain further information, address inquiries to:

Joe Moutvic
Department Chairman
Marine Science Technology Department
Miami Dade Community College
1090 N.W. North River Drive
Miami, Florida 33136

MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48823

Michigan State University has research and teaching facilities for work in limnology and oceanography on the main campus in East Lansing and at the W.K. Kellogg Biological Station at Hickory Corners, Michigan. In addition, use is made of the nearby Great Lakes and of affiliations with several marine stations.

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* With permission of Department Chairman only.

Facilities on the main campus are available through the Departments of Fisheries and Wildlife and Geology. The facilities include numerous laboratories with standard analytical equipment; a special laboratory with 19 ponds for controlled experiments on the banks of the Red Cedar River on the main campus; a nuclear reactor; an automated, multichannel gamma counter for neutron activation analysis and isotope analyses; a scanning electron microscope; an electron microprobe; an x-ray diffraction meter; x-ray fluorescence equipment; an infrared spectrometer; a coulter counter; chromatographs, a seismic play-back center; bomb calorimeter; and a carbon analyzer. Field equipment includes a 20-foot launch and many smaller boats; biological-sediment- and water-sampling devices; magnetometers; gravity meters; a seismic van and requisite support equipment. The W.K. Kellogg Biological Station is a separate entity affiliated through teaching and research programs with the College of Natural Science. Courses are offered during the summer session and research conducted throughout the year. Laboratory and boat facilities are duplicated at the station.

The following degrees are offered:

1. B.S. in Fisheries and Wildlife, specializing in Fishery Biology and Limnology. Requirements: 43 credits in the social sciences and humanities; completion of credits in biological sciences, chemistry, geology, mathematics, physics and soil science; 40 to 43 credits in professional core curriculum for specialty, and 23 to 49 other elective credits.

2. M.S. in Fisheries and Wildlife, specializing in Fish Management, Fishery Biology, Limnology or Pollution Biology. Requirements: completion of 45 credits past the bachelor's degree of which 8 to 22 hours must be in research and completion and defense of a master's thesis.

3. Ph.D. in Fisheries and Wildlife, with specialties in the above. Requirements: completion of a minimum of 36 credits above the equivalent of a master's degree; 12 credits in thesis research and successful completion of a dissertation; competence in one or two of the following areas for which nine credit hours may be taken: education, communications, foreign language, computer science, systems science, philosophy, mathematics or any other discipline acceptable to the student's committee, and oral or written examinations for degree candidacy and for defense of the dissertation.

4. B.S. in Geology, with specialization in Marine Geology, Geophysics or Geochemistry. Requirements: 60 non-science credits; mathematics through Calculus III or Calculus II plus a course in statistics; chemistry equivalent to three quarters of study; 12 credits in physics; geology courses and a total of at least 180 hours. Courses in marine and aquatic sciences offered in fisheries and wildlife are considered as non-science electives and are strongly encouraged.

5. M.S. in Geology, with specialization in Marine Geology, Geophysics or Geochemistry. Requirements: minimum of 45 credits of which up to 10 can be for thesis research and completion and defense of a master's thesis.

6. M.A.T. in Geology with specializations as above. Requirements: Candidates must have a teaching certificate prior to receipt of the degree, a minimum of 45 credits, in addition to those required for the teaching certificate, and successful completion of a comprehensive examination, oral or written.

7. Ph.D. in Geology with specializations as above. Requirements: completion of a suitable curriculum as determined by the candidate and his guidance committee, completion of a foreign language requirement or a suitable substitute as approved by the guidance committee, oral and/or written examinations for degree candidacy, which must be passed prior to initiation of dissertation research, and for defense of the dissertation, and successful submission of a dissertation.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

FW	374	Biological Oceanography	3
FW	471	Ichthyology	3
FW	473	Fishery Biology and Management	5
FW	476	Limnology	3
FW	477	Limnological Methods	3
GLG	201	General Geology - Physical	4
GLG	202	General Geology - Historical	4
GLG	205	Oceanology: The Marine Environment and Man	3
GLG	400H	Honors Work	-
GLG	432	Introduction to Meteorology	3
GLG	433	Introductory Meteorology Lab	1
GLG	445	Field Studies	-
GLG	474	Geophysical Methods	4
GLG	475	Geophysics	3
GLG	492	Sedimentology I	3
GLG	493	Sedimentology II	3
GLG	495	Geochemistry I	3
GLG	496	Geochemistry II	3

GRADUATE COURSES

FW	802	Chemical Limnology	3
FW	874	Advanced Biological Limnology	3
FW	899	Research - Master's	-
FW	999	Research - Doctoral	-

Additional courses are available in the Departments of Civil and Sanitary Engineering, Botany, Zoology, Resource Development and Physics that may be applied to the student's curriculum in order to allow specialization in any of the subdivisions in Marine Science.

The instructional staff for the courses listed above consists of the following:

FISHERIES AND WILDLIFE

Bahr, T.G., Ph.D., Assistant Professor
Ball, R.C., Ph.D., Professor and Director of the Institute of Water Research
D'Itri, F.M., Ph.D., Assistant Professor
Kevern, N.R., Ph.D., Professor and Chairman
McNabb, C.D., Ph.D., Associate Professor
Roelofs, E.W., Ph.D., Professor
Tack, P.I., Ph.D., Professor

GEOLOGY

Anstey, R.L., Ph.D., Assistant Professor
Bennett, H.F., Ph.D., Assistant Professor

Carmichael, R., Ph.D., Assistant Professor
Cross, A.T., Ph.D., Professor
Ehrlich, R., Ph.D., Associate Professor
Fisher, J.H., Ph.D., Professor
Spooner, C.M., Ph.D., Assistant Professor
Upchurch, S.B., Ph.D., Assistant Professor

W.K. KELLOGG BIOLOGICAL STATION

Cummins, K.W., Ph.D., Associate Professor
Hall, D.J., Ph.D., Associate Professor
Klug, M.J., Ph.D., Assistant Professor
Lauff, G.H., Ph.D., Professor and Director
Wetzel, R.G., Ph.D., Professor

To obtain further information, address inquiries to:

Chairman
Department of Geology
Michigan State University
East Lansing, Michigan 48823

MISSISSIPPI STATE UNIVERSITY
Mississippi State, Mississippi 39762

Mississippi State University has marine-related research and teaching facilities on the main campus near Starkville and on site at the National Space Technology Laboratory of NASA at Bay St. Louis, MS. Facilities on campus include classrooms, computers, an electron microscopy lab, chemical and biological analysis laboratories, and related support services. At NSTL, MSU operates field experiments, chemical and biological laboratories, land and water transportation services, and conference facilities. MSU also utilizes Mississippi's Gulf Coast Research Laboratory in marine-related education, research, and advisory services programs. (See GCRL for facilities.)

The following degrees or marine science related options are offered:

College of Engineering, Department of Mechanical Engineering: Bachelor of Engineering Technology (Marine Engineering Technology).

Mississippi State University offers a degree in Marine Engineering Technology at its main campus location.

The Marine Engineering Technology curriculum leads to the degree of Bachelor of Science in Marine Engineering Technology. The program is designed to prepare students to enter the marine construction industry. Primary emphasis is placed on the many engineering and management aspects of ship construction. Laboratory facilities are shared with other departments in the College of Engineering which have a total laboratory space of 170,000 square feet.

A 134 semester hour curriculum constitutes the requirements for the degree. The first two years of the curriculum may be taken at a junior college or community college. Coursework taken during these two years should consist of usual pre-engineering courses such as calculus, chemistry, engineering graphics, physics, descriptive geometry, etc.

College of Arts and Sciences: Master of Science with marine specialities in botany, geology, microbiology or zoology. Requirements: 30 semester hours, one foreign language and thesis. Ph.D. with marine specialities in botany, microbiology or zoology. Requirements: varied coursework, minimum of one foreign language and dissertation.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

BOT 1003	General Botany
BOT 1013	General Botany I
BOT 1023	General Botany II
BOT 1083	Honors General Botany I
BOT 1093	Honors General Botany II
CET 3023	Marine Structures
GET 2303	Applied Thermodynamics
GET 2403	Metals Technology
GET 2503	Oceanography I
GET 2603	Oceanography II
GET 3003	Introduction to Underwater Acoustics
GET 3323	Applied Dynamics
GG 1011	Earth Sciences I Laboratory
GG 1013	Survey of Earth Sciences I
GG 1021	Earth Science II Laboratory
GG 1023	Survey of Earth Sciences II
GG 1093	Honors in Physical Geology
GG 2053	Advanced General Geology
GG 3033	Introduction to Environmental Geology
MAT 2003	Mechanics and Materials I
MAT 2004	Shipbuilding Tech. I
MAT 2104	Marine Engineering Tech. I
MAT 2014	Mechanics and Materials II
MAT 2403	Metals Technology
MAT 2604	Naval Architecture Tech. I
MAT 3014	Shipyard Operations Tech.
MAT 2513	Oceanography I
MAT 3134	Outfitting of Steel Ships
MAT 3123	Marine Engineering Tech. II
MAT 3323	Applied Dynamics
MAT 3614	Naval Architecture Tech. II
MAT 2523	Oceanography II
MAT 3024	Shipbuilding Tech. II
MAT 3033	Shipbuilding Tech. III
MAT 3404	Shipboard Ventilation
MAT 3723	Naval Architecture III
MIC 1113	Elementary Microbiology
MIC 1214	General Microbiology
MIC 2424	Bioinstrumentation
ZO 1001	Biological Science Laboratory
ZO 1003	Introduction to Biological Science
ZO 1094	Honors in General Zoology
ZO 1314	Invertebrate Zoology
ZO 2614	Biology of Vertebrates
ZO 3014	Introduction to Marine Zoology
ZO 31[illegible]	Vertebrate Morphology I
ZO 3125	Vertebrate Morphology II
ZO 3714	Ecology
ZO 3813	Biological Techniques
ZO 4000	Special Problems

UNDERGRADUATE/GRADUATE COURSES

BOT 4103/6103	Taxonomy of Spermatophytes
BOT 4114/6114	General Plant Physiology
BOT 4133/6133	Plant Ecology
BOT 4904/6904	Introduction to Marine Botany
BOT 5103/7103	Cytology
GG 4303/6303	Introduction to Stratigraphy and Sedimentation
GG 4413/6413	Physical Marine Geology
GG 4423/6423	Chemical Marine Geology
GG 4503/6503	Geomorphology
GG 4603/6603	Engineering Geology
GG 5323/7323	Gulf Coast Stratigraphy
MIC 4321/6231	Microbiological Literature
MIC 4324/6324	Microbiology of Water and Sewage
MIC 4113/6413	Quantitative Microbiology I
MIC 5213/7213	Microbial Physiology I
MIC 5225/7225	Quantitative Methods II
MIC 5414/7414	Radioisotope Techniques I
ZO 4326/6326	Marine Invertebrate Zoology I
ZO 4336/6336	Marine Invertebrate Zoology II
ZO 4636/6636	Marine Vertebrate Zoology and Ichthyology
ZO 4824/6824	Marine Fisheries Biology

GRADUATE COURSES

BOT 7000	Special Problems
BOT 8000	Thesis Research/Thesis
BOT 8104	Morphology of Algae
BOT 8112	Botanical Literature
BOT 8124	Advanced Anatomy
BOT 8144	Cytogenetics
BOT 8163	Advanced Plant Physiology I
BOT 8173	Advanced Plant Physiology II
BOT 8801-8821	Seminar
BOT 9000	Dissertation Research/Dissertation
GG 7000	Special Problems
GG 8000	Thesis Research/Thesis
GG 8164	Earth Sciences I
GG 8174	Earth Sciences II
GG 8333	Sedimentology
GG 8551-8561	Graduate Seminar
GG 8572	Geologic Literature
GG 8623	Special Topics in Geology
GG 9163	Sedimentary Petrology
MIC 7000	Special Problems
MIC 8000	Thesis Research/Thesis
MIC 8201-8211	Seminar
MIC 8235	Mathematical Microbiology
MIC 8253	Quantitative Microbiology III
MIC 8293	Microbial Genetics
MIC 8324	Applied Microbiology
MIC 8414	Radioisotope Techniques II
MIC 9000	Dissertation Research/Dissertation
ZO 7000	Special Problems
ZO 8000	Thesis Research/Thesis
ZO 8213	Comparative Physiology
ZO 8314	Advanced Invertebrate Zoology
ZO 8633	Vertebrate Ethology
ZO 8713	Advanced Ecology
ZO 8802	Scientific Writing for Biological Students
ZO 8811-8831	Seminar
ZO 8943/8993	Special Topics in Zoology
ZO 9000	Dissertation Research/Dissertation

The instructional staff for the courses listed consists of the following:

MARINE ENGINEERING TECHNOLOGY

Anderson, Clifford F., M.S., Associate Professor
Bryant, Glenn D., M.S., Associate Professor
Hsiung, Chi-Chao, Ph.D., Associate Professor

BOTANY

Hare, M.L., Ph.D., Associate Professor
Hickok, L.G., Assistant Professor
Lane, H.D., Ph.D., Adjunct Associate Professor
McDaniel, S.T., Ph.D., Associate Professor
Price, J.A., Jr., Ph.D., Assistant Professor
Watson, J.R., Jr., Ph.D., Associate Professor and Head

GEOLOGY

Keady, D.M., Ph.D., Associate Professor of Geology and Geography
Laswell, T.J., Ph.D., Professor of Geology and Geography and Head of the Department
Lins, T.W., Ph.D., Assistant Professor of Geology and Geography
Russel, E.E., Ph.D., Professor of Geology and Geography

MICROBIOLOGY

Brown, L.R., Ph.D., Associate Dean of Arts and Sciences and Professor of Microbiology
Cook, D.W., Ph.D., Assistant Professor of Microbiology
McCamish, J., Ph.D., Associate Professor of Microbiology
Mickelson, J.C., Ph.D., Professor of Microbiology
Stojavonic, B.J., Ph.D., Professor of Agronomy
Tischer, R.G., Ph.D., Professor of Microbiology and Head of the Department
Wang, A.W.S., Ph.D., Assistant Professor of Microbiology

ZOOLOGY

Altig, R.G., Ph.D., Associate Professor
Clemmer, G.H., Ph.D., Associate Professor
Cross, W.H., Ph.D., Adjunct Professor
De la Cruz, A.A., Ph.D., Associate Professor
Dawson, C.E., B.S., Adjunct Associate Professor
Morrow, J.T., Ph.D., Professor and Head of the Department
Yarbrough, J.D., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. C.T. Carley, Ph.D., P.E.
Mississippi State University
Drawer ME
Mississippi State, Mississippi 39762

NAVAL POSTGRADUATE SCHOOL
Monterey, California 93940

The Departments of Oceanography and Meteorology offer graduate education for active duty military officers, civilian employees of the Federal government and officers of allied nations. Classroom instruction is supplemented by laboratory exercises both ashore and afloat. The 126-foot oceanographic and hydrographic Research Vessel Acania is sponsored by the Oceanographer of the Navy for class laboratory experience as well as for individual research efforts. Guest lectures, seminars, and in situ study at the Naval Arctic Research Laboratory in Barrow, Alaska are part of the program. Laboratory facilities include a small sediments laboratory, a biological laboratory, as well as chemical and geological laboratories. Also utilized are facilities in the Departments of Electrical Engineering, Mathematics, Meteorology, Mechanical Engineering, Computer Science and Physics and Chemistry.

The following degrees are offered:

1. Master of Science in Oceanography and Master of Science in Oceanography (Hydrography). Offered by the Oceanography Department, the curriculum is interdisciplinary and encompasses a broad spectrum of physical, chemical, biological and geological oceanography which is directly related to oceanographic support of military operations. The oceanography student may choose to pursue studies in hydrography as a program option in which coursework is supplemented or replaced with study in Geodesy, Photogrammetry, Cartography and Hydrography. Approximately 25 students are graduated each year. Entrance requirements include a baccalaureate degree or equivalent with above average grades in mathematics and the physical sciences. Differential and integral calculus, one year of college physics, and one year of college chemistry are required. Requirements for the degree include the completion of 35 quarter hours of graduate courses of which 15 hours must be in the 4000 oceanography series. The entire program must be approved by the Department of Oceanography. An acceptable thesis on a topic approved by the Department of Oceanography is also required.

2. Master of Science in Meteorology and Oceanography. Offered by the Meteorology and Oceanography Departments, the Air-Ocean Science curriculum is interdisciplinary and encompasses those areas of meteorology and oceanography which are directly related to environmental support of military operations. The program consists of preparatory subjects, basic courses in dynamic and physical meteorology and oceanography, and a sequence in environmental analysis and forecasting, including numerical methods by computer. The program recognizes the importance of interactions between the atmosphere and the oceans, and deals with their relationships at the air-sea interface. Between 10 to 12 students are graduated each year. Entrance requirements include a baccalaureate degree in either meteorology or oceanography. Requirements for the degree include completion of 48 quarter hours of graduate courses in meteorology and oceanography and an acceptable thesis on a topic approved by either department. The entire program must be approved by both the Department of Meteorology and the Department of Oceanography.

3. Master of Science in Engineering Acoustics is offered as an interdisciplinary program with courses drawn principally from the fields of electrical engineering and physics. Although broadly based, the emphasis is on those aspects of acoustics concerning propagation of sound in the oceans, in applications of underwater sound, and on the electrical engineering of instrumentation for underwater sound detection. Between six and 10 students are graduated each year. Entrance requirements include a baccalaureate degree in engineering or physical science. Requirements for the degree include a minimum of 36 graduate credit quarter hours of coursework of which at least 20 graduate quarter hours must be taken in acoustics and its applications. One course from each of three of the following areas must be included: wave propagation, vibration and noise control, transducer theory, sonar systems, and signal processing. An acceptable thesis must be completed. The entire program must be approved by the Engineering Acoustics Academic Committee.

4. Ph.D. in Oceanography, Meteorology and Oceanography/Meteorology. Offered by the Oceanography and Meteorology Departments, specific entrance and degree requirements can be obtained from the Department Chairmen.

The following courses, where 3000 and 4000 numbers denote graduate credit, are offered in conjunction with the above programs:

DEPARTMENT OF OCEANOGRAPHY

2110	Introduction to Oceanography	3-0
2120	Survey of Oceanography	4-0
2430	Environmental Pollution	3-0
3150	Geophysical Random Processes	4-2
3220	Physical Oceanography I	3-0
3221	Physical Oceanography II	3-3
3261	Oceanographic Factors in Underwater Sound	4-0
3265	Environmental Factors in Underwater Acoustics	4-0
3270	Bioacoustical Oceanography	3-0
3320	Geological Oceanography	3-3
3321	Geophysics	3-0
3322	Principles of Geology	2-0
3420	Biological Oceanography	3-3
3520	Chemical Oceanography	3-3
3610	Wave Forecasting	2-2
3617	Acoustic Forecasting	2-2
3621	Regional Oceanography	1-4
3625	Environmental Prediction for Underwater Sound Propagation	2-1
3709	Scientific Cruise Experience	0-4
3801	Ocean Operations I	3-1
3820	Principles of Measurement	3-2
3902	Basic Hydrography	3-3
3903	Photogrammetry	3-2
3904	Hydrographic Measurements	3-2
3905	Hydrographic Operations	3-2
3909	Hydrographic Cruise	0-4
4211	Waves and Tides	4-0
4212	Tides	1-0
4213	Coastal Oceanography	3-2
4260	Sound in the Sea	4-0
4321	Introductory Geophysical Fluid Dynamics	4-0
4322	Ocean Dynamics	4-0
4421	Marine Ecology	1-4
4422	Marine Biodeterioration	1-1
4612	Polar Oceanography	3-2

4800	Special Topics in Oceanography	3-0
4802	Ocean Operations II	3-1
4803	Physical Properties of Marine Sediments	2-3
4860	Physics of the Earth	3-0
4906	Geodesy	4-0
4907	Cartography	3-2

DEPARTMENT OF METEOROLOGY

2200	Introduction to Meteorology	4-0
2210	Introduction to Meteorology/Laboratory	4-2
2413	Meteorology for Antisubmarine Warfare	3-0
2416	Meteorology for Electronic Warfare	2-0
2520	Climatology and Statistics	3-1
3222	Meteorological Analysis	4-3
3232	Tropospheric and Stratospheric Meteorology	4-8
3252	Tropical Meteorology	3-4
3262	Prognostic Charts and Forecasting Weather Elements	3-4
3321	Air-Ocean Fluid Dynamics	4-0
3420	Geophysical Thermodynamics	4-0
3421	Cloud Physics	3-0
3512	Heat Transfer Processes	4-0
4241	Mesoscale Meteorology	3-0
4242	Advanced Tropical Meteorology	3-0
4250	General Circulation of the Atmosphere and Oceans	3-0
4322	Dynamic Meteorology	4-0
4323	Numerical Air and Ocean Modeling	4-3
4324	Advanced Numerical Weather Prediction	3-0
4331	Advanced Geophysical Fluid Dynamics I	3-0
4332	Advanced Geophysical Fluid Dynamics II	3-0
4415	Atmospheric Turbulence	3-0
4416	Atmospheric Factors in Electromagnetic Propagation	3-0
4417	Topics in Remote Sensing and Satellite Observations	3-0
4900	Special Topics in Meteorology	-

DEPARTMENTS OF OCEANOGRAPHY AND METEOROLOGY

3212	Polar Oceanography and Meteorology	3-1
3240	Operational Environmental Products	0-4
4413	Air-Sea Interaction	4-0

DEPARTMENT OF PHYSICS AND CHEMISTRY

2151	Mechanics I	4-1
2265	Geometrical Optics	2-2
3152	Mechanics II	4-0
3161	Fluid Dynamics	4-1
3360	Electromagnetic Wave Propagation	4-1
3431	Physics of Sound in the Ocean	4-2
3451	Fundamental Acoustics	4-1
3452	Underwater Acoustics	4-2
3458	Noise, Shock and Vibration Control	4-0
4400	Advanced Acoustics Laboratory	0-6
4453	Radiation and Scattering of Waves in Fluids	4-0
4454	Transducer Design and Theory	3-2
4456	Seminar in Applications of Underwater Sound	3-0
4459	Shock Waves and High Intensity Sound	3-0

DEPARTMENT OF ELECTRICAL ENGINEERING

2103	Linear Systems Analysis	4-2
2107	Introduction to Electrical Engineering	4-2
2114	Communications Theory	4-1
2211	Electronics Fundamentals	-
2212	Electronics Engineering Fundamentals	4-3
2810	Digital Machines	3-3
3571	Stochastic Analysis of Signals	4-1
4451	Sonar Systems Engineering	4-2
4572	Statistical Communication Theory	3-2

The instructional staff for the above courses consists of the following:

DEPARTMENT OF OCEANOGRAPHY

Andrews, R.S., Ph.D., Associate Professor
Bourke, R.H., Ph.D., Associate Professor
Denner, W.W., Ph.D., Associate Professor
Dunlap, C.R., M.S., Assistant Professor
Garwood, R.W., Jr., Ph.D., Adjunct Professor
Haderlie, E.C., Ph.D., Distinguished Professor
Jung, G.H., Ph.D., Professor
Leipper, D.F., Ph.D., Professor
Milne, A.R., M.S., Adjunct Professor
Mooers, C.N.K. Ph.D., Professor, Department Chairman
Nortrup, D.E., M.S., Assistant Professor
Paquette, R.G., Ph.D., Professor
Stanton, T.P., M.S., Adjunct Professor
Thompson, W.C., Ph.D., Professor
Thornton, E.B., Ph.D., Associate Professor
Traganza, Ph.D., E.D., Associate Professor
Tucker, S.P., Ph.D., Assistant Professor
Von Schwind, J.J., Ph.D., Associate Professor
Wickham, J.B., M.S., Associate Professor

DEPARTMENT OF METEOROLOGY

Chang, C.P., Ph.D., Associate Professor
Davidson, K.L., Ph.D., Associate Professor
Elsberry, R.L., Ph.D., Associate Professor
Haltiner, G.J., Ph.D., Distinguished Professor, Department Chairman
Haney, R.L., Ph.D., Associate Professor
Lau, K.W., Ph.D., Adjunct Assistant Professor
Renard, R.S., Ph.D., Professor
Van der Bijl, W., Ph.D., Associate Professor
Williams, F.R., M.S., Assistant Professor
Williams, R.T., Ph.D., Professor

ENGINEERING ACOUSTICS ACADEMIC COMMITTEE

Sackman, G.L., Ph.D., Associate Professor of Electrical Engineering
Wilson, O.B., Jr., Ph.D., Professor of Physics and Chemistry, Committee Chairman

Other professors involved include:

Coppens, A.B., Ph.D., Associate Professor of Physics and Chemistry
Medwin, H., Ph.D., Professor of Physics and Chemistry
Myers, G.A., Ph.D., Professor of Electrical Engineering
Sanders, J.V., Ph.D., Associate Professor of Physics and Chemistry
Stentz, D.A., M.S., Associate Professor of Electrical Engineering
Titus, H.A., Ph.D., Professor of Electrical Engineering

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To obtain further information, address inquiries to:

Cdr. L.A. Yeske, U.S. Navy, Ph.D., Director
Environmental Sciences Programs
Naval Postgraduate School
Monterey, California 93940
(408) 646-2044

NEW JERSEY MARINE SCIENCES CONSORTIUM

Princeton, New Jersey 08540

The New Jersey Marine Sciences Consortium operates two field stations for teaching and research. The northern field station is located at Sandy Hook within the Gateway National Recreation area; the southern field station is in Seaville, Cape May County. Both field stations provide teaching and research laboratories, classrooms, and libraries. Housing and food services are available all year at Seaville and during the summer months at Sandy Hook. Vessels range from 16 feet to 34 feet. Both field stations provide laboratory, field equipment, and sampling gear for use on the vessels.

The NJMSC is a non-profit corporation comprised of 23 member institutions:

Atlantic Community College, Mays Landing, NJ
Bergen Community College, Paramus, NJ
Brookdale Community College, Lincroft, NJ
Cumberland County College, Vineland, NJ
Essex County College, Newark, NJ
Fairleigh Dickinson University, Rutherford, NJ
Glassboro State College, Glassboro, NJ
Jersey City State College, Jersey City, NJ
Kean College of New Jersey, Union, NJ
Lehigh University, Bethlehem, PA
Monmouth College, W. Long Branch, NJ
Montclair State College, Upper Montclair, NJ
New Jersey Institute of Technology, Newark, NJ
Princeton University, Princeton, NJ
Ramapo College, Mahwah, NJ
Rider College, Lawrenceville, NJ
Rutgers University, New Brunswick, NJ
Seton Hall University, South Orange, NJ
Stevens Institute of Technology, Hoboken, NJ
Stockton State College, Pomona, NJ
Trenton State College, Trenton, NJ
Union College, Cranford, NJ
William Paterson College, Wayne, NJ

Graduate and undergraduate courses for credit are taught at the NJMSC field stations. Students must register through a member institution to gain credit.

While the NJMSC is not a degree-granting institution, credits for the courses offered are applied to undergraduate or graduate degree programs at the member institutions or transferred to another institution. Students from out of state and from non-member institutions may take courses provided they register through a member institution.

The following courses are offered by the NJMSC during the summer. Expansion of the program through the academic year is anticipated. Not all courses are offered each year.

UNDERGRADUATE COURSES

(200/300/400 level)

Introduction to the Marine Sciences	4
Introduction to Marine Biology	4
Oceanography	4
Field Methods in the Marine Sciences	4
Seashore Entomology	2
Biology of Marine Fishes	4
Seashore Ornithology	2
Marsh and Dune Vegetation	2
Introduction to Physical Oceanography	4
Coastal Marine Geology	4
Chemical Oceanography	4
Marine Ecology	4
Scientific Illustration	1
Scientific Photography	2

UNDERGRADUATE/GRADUATE COURSES

(400/500 level)

Marine Invertebrates:	
Protozoa - Amoeboid and Sporozoan	1
Protozoa - Ciliated	1
Flagellated Protozoa and Porifera	1
Coelenterata and Ctenophora	1
Worm Phyla	1
Mollusca	1
Anthropoda	1
Bryozoa, Echinodermata and Protochordata	1
Marine Procaryota: Bacteria and Cyanophyta	2
Marine Dinoflagellates and Diatoms	2
Marine Botany I: Chlorophyta, Euglenophyta and Phaeophyta	2
Marine Botany II: Rhodophyta and Fungi	2
Independent Study in the Marine Sciences	Arranged
Marine Invertebrate Paleobiology	4
Man's Impact on the Coastal Zone	4

GRADUATE COURSES

(500 level)

Ichthyoplankton	2
Marine Algal Physiology	4
Coastal Geomorphology	4
Tidal Marsh Ecology	4
Ecology of the Estuary	4
Marine Science Education	4

NON-CREDIT COURSES

Basic Scuba
Scuba-Sport Diving

Faculty for the above courses is drawn from the member institutions, other colleges and universities, and the government.

To obtain further information, address inquiries to:

(Please see next page)

Janet C. Jessel, Director
Educational Programs
New Jersey Marine Sciences Consortium
101 College Road East
Princeton Forrestal Center
Princeton, New Jersey 08540
(609) 452-8465

NEW YORK OCEAN SCIENCE LABORATORY

Montauk, New York 11954

The New York Ocean Science Laboratory (NYOSL), a center for integrated programs of research and development in the marine sciences, was founded by its present director, Dr. John C. Baiardi. The laboratory is operated under the auspices of a consortium of eight metropolitan colleges and universities known as Affiliated Colleges and Universities, Inc.

The member institutions of the consortium include: Adelphi University, Fordham University, Hofstra University, Long Island University, New York University, St. John's University, New York Institute of Technology and State University of New York. The Laboratory supplements and augments the programs provided by the consortium. Courses are offered at the Laboratory in conjunction with them. However, NYOSL does not itself grant degrees.

It does provide opportunity for sponsored thesis research which is applicable towards an M.S. and Ph.D. degree granted by the member institution. It also offers:

a) Internship Program in effect with several colleges where qualified students are admitted to a one-semester work experience at NYOSL. The student receives up to 16 hours of credit from the home institution.

b) A Minimester Program where research experience is provided during the three-four week period in the Winter recess.

c) Trainee-volunteer program for qualified graduate and undergraduate students for research experience during the Fall, Spring or Summer periods.

The Laboratory supports multi-disciplined research and education in various facets of marine science. It has laboratories and research programs in microbiology, phytoplanktonology, zooplanktonology, ichthyology, macroalgae, chemical oceanography, natural products chemistry, physical oceanography, meteorology, vertebrate and invertebrate marine biology and mariculture of lobsters, clams, mussels and finfish, such as striped bass, flounder and eels.

The New York Ocean Science Laboratory also has the necessary basic laboratory equipment and supplies to support its programs. Among the special equipment are: electron microscopes, both penetrating (RCA) and scanning (JEOL-S25), with the necessary specimen-preparation and film-processing facilities, gas chromatography equipment for hydrocarbon analysis, controlled temperature environmental chambers of various sizes, two atomic absorption machines, ultraviolet, infrared and DU spectrophotometers, gamma and beta scintillators, Technicon (four channel) and a high pressure liquid chromatography unit. The data generated is stored by means of a telephone tie-line to the Brookhaven National Laboratory's computer bank.

There are several running seawater laboratories containing both indoor and outdoor tanks. These can be managed in flowthrough or recycled modes and the water can be filtered and temperature controlled. These facilities are associated with the mariculture programs as are the greenhouses for the growth of algae and the baby bivalves.

A weather station measures wind speed, barometric pressure, temperature-humidity and solar radiation. The NYOSL library has more than 8,000 volumes and includes the Long Island Collection which was funded through a grant from the Hayden Foundation. This collection provides a complete library of all the research known to the Laboratory involving the waters around Long Island.

Located on 36 acres at Fort Pond Bay, Montauk, New York, the site and accommodations of the various buildings, with more than 300,000 square feet of available floor space, make them well suited for an oceanology complex. An 850-foot, L-shaped pier and helicopter pad are available. More than 80,000 square feet of available space have been converted into ocean science and research laboratories.

Among the vessels used by the Laboratory are: a 42-foot refitted sports fisherman, three Boston Whalers and a catamaran fitted for inshore seining.

Laboratory staff involved in various research projects are:

Baiardi, John C., Ph.D., Director

Senior Research Scientists

D'Agostino, Anthony, Ph.D., Marine Biology
Hollman, Rudolph, Ph.D., Physical Oceanography

Research Scientists

Sharma, Gurdial M., Ph.D., Chemical Oceanography

Associate Research Scientists

Turner, Jefferson T., Ph.D., Zooplanktonology

Assistant Research Scientists

Bruno, Stephen F., Ph.D., Phytoplanktonology
Han, Maung Htun, Ph.D., Finfish Biology
Larson, Ralph J., Ph.D., Fisheries Biology
Noyes, George S., Ph.D., Shellfish Biology

Librarian

Bodnar, John, B.S.

Research Associates

Benjaminson, Morris A., Ph.D., Microbiology, Director, North Star Research
Diamond, Edward H., M.S., Energy Engineering, Manager, Advanced Concepts, Grumman Energy Systems

Elgart, Robert L., Ph.D., Microbiology, Chairman, Biology Department, State University of New York at Farmingdale

Frizzola, John A., Meteorology, Suffolk County, Department of Environmental Control

Hahn, Steven M., M.S., Electronics, President, Detectron Security Systems, Inc.

Leff, Eugene, Ph.D., Ichthyology, Associate Professor of Biology, Queensborough Community College

Muller, William A., Ph.D., Marine Biology, Assistant Professor of Life Sciences, New York Institute of Technology

Newman, Gerhard, Ph.D., Physical Oceanography, Professor, Department of Earth and Planetary Sciences, City University of New York

Perlmutter, Alfred, Sc.D., Ichthyology, Professor of Biology, New York University

Rachlin, Joseph W., Ph.D., Biology, Associate Professor, Department of Biological Sciences, Herbert H. Lehman College

Ruggieri, George D., Ph.D., Marine Biomedicine, Director, Osborn Laboratories of Marine Sciences

Tangredi, Basil P., D.V.M., Necropsy and Wildlife Diseases, Owner, Greenlawn Veterinary Clinic

Thatcher, M. Llewellyn, Sc.D., Physical Oceanography, Associate Research Professor, Department of Civil and Environmental Engineering, Polytechnic Institute of New York

Udell, Harold F., M.S.C.E., Sanitary Engineering, Commissioner, Department of Conservation and Waterways, Town of Hempstead

Uttley, David E., B.S., Invertebrate Biology, Captain and Manager, Bluepoints Company, Inc.

Weis, Judith, Ph.D., Embryology, Associate Professor, Rutgers University

Weis, Peddrick, Ph.D., Neural Anatomy, Associate Professor, College of Medicine and Dentistry of New Jersey, New Jersey Medical School

Wishner, Frederick B., D.C., Marine Biology, Aqualife Farms, Inc.

To obtain further information, address inquiries to:

Dr. John C. Baiardi, President-Director
New York Ocean Science Laboratory
Edgemere Road
Montauk, New York 11954
(516) 668-5800

NICHOLLS STATE UNIVERSITY
Thibodaux, Louisiana 70301

Nicholls State University has a marine science laboratory at Port Fourchon (near Grand Isle), Louisiana. This facility is used for marine and estuarine research projects and for field trips by the University's students and faculty. The physical facility includes a portable walk-in cold room, a shop, instrument and storage rooms, a dry laboratory and a large area which is utilized as a wet laboratory. The facility has complete dining and sleeping facilities for sixteen persons. A Boston Whaler equipped with two 70 horsepower outboard motors, along with several aluminum skiffs are available. In addition to these vessels, the University leases a 65-foot shrimp trawler for use in conducting marine research on the Louisiana continental shelf. Specialized equipment located either at the laboratory or at the University's main campus includes salinometer, pH meters, spectrophotometers, gas-liquid chromatography, thin-layer chromatography, electrophoresis, oxygen analyzers, BOD and COD analyzers, sediment analysis equipment, incubators, centrifuges, microscopes and photographic equipment.

The University awards the Bachelor of Science degree, with a major in Marine Biology, to a student who, in addition to satisfying the minimum requirements for graduation from the College of Life Sciences and Technology, meets the following requirements:

1. Completion of the curriculum outlined for Marine Biology majors with a grade of "C" or better in all science courses.

2. Completion of 49 hours of biological science courses to include Biology 101, 102, 103, 104, 320, 321, 481, 482; four hours of Botany electives; Microbiology 303, 304; Zoology 252, 253, 348, 349, 404, 405; and 12 hours of Biological Science Electives. A Biological Science Elective includes those courses titled Biology, Botany, Microbiology and Zoology.

3. Students wishing to minor in Chemistry must take Chemistry 105, 106, 110, 221, 222, 226, 300, 302 and at least three (3) additional hours in other Chemistry courses approved by the Head of the Chemistry Department. A student wishing to minor in some other academic field must consult with his advisor.

Undergraduate marine, geology and geography courses also are offered to prepare students for graduate work in the marine environment or simply to add depth to their general background.

The following courses are offered each year by the University in conjunction with the above program:

UNDERGRADUATE COURSES

Biology 375	Principles and Practice of Scuba Diving	2
Biology 415	Research Techniques	3
Biology 416	Research Problems	-
Biology 481-482	Aquatic Ecology and Laboratory	4
Botany 405-406	Phycology and Laboratory	4
Geography 331	Coastal Geomorphology	3
Geography 332	Coastal Management	3
Geography 368	Geography of Louisiana	3
Geology 300	Oceanography	3
Geology 302	Principles of Sedimentation	3
Geology 408	Origin, Migration, Accumulation and Geologic Distribution of Petroleum	3
Geology 412	Oceanography Seminar	1
Zoology 330-331	Aquaculture and Laboratory	4
Zoology 348-349	Ichthyology	4
Zoology 404-405	Fisheries Management and Laboratory	4

The instructional staff for the courses listed above consists of the following:

BIOLOGY, BOTANY, ZOOLOGY

Green, John H., Professor
Kilgen, Ronald H., Associate Professor
Melancon, Earl, Instructor
Ragan, James G., Professor

GEOGRAPHY

Davis, Donald W., Associate Professor
Gary, Don L., Associate Professor

GEOLOGY

Givens, Charles R., Assistant Professor
Sachs, Jules B., Professor
Self, Robert P., Associate Professor

To obtain further information, address inquiries to:

Dr. John H. Green, Director
Nicholls State University Marine Laboratory
Department of Biological Sciences
P. O. Box 2021
Thibodaux, Louisiana 70301

NORTH CAROLINA STATE UNIVERSITY
Raleigh, North Carolina 27650

The graduate program in Marine Science is offered by the Department of Marine Science and Engineering. The laboratories and teaching facilities of the Department are located on the Raleigh campus. Access to coastal facilities are available through co-operative arrangements with other organizations. Such arrangements have been made with Duke University and the National Marine Fisheries Laboratory at Beaufort, the North Carolina Marine Resources Center at Manteo, Bogue Banks and Ft. Fisher and at UNC's Marine Institute at Morehead City, North Carolina.

The Department operates a small vessel for estuarine work but major cruises are carried out aboard Duke's vessels the Eastward and John DeWolf or Cape Fear Technical Institutes' vessel Advance II. Research cruises have also been done co-operatively with institutions outside the State such as the University of Georgia and the University of Rhode Island.

The M.S. and Ph.D. degrees are offered in the areas of Biological, Chemical, Geological and Physical Oceanography and Coastal Engineering. The M.S. degree normally requires a minimum of 30 credit hours with concentration in one of the above areas. It is possible to obtain the M.S. degree with or without a thesis. The Ph.D. requirements are normally determined by the student's advisory committee and is intended to meet the individual academic needs of each Ph.D. student.

There are core course requirements for both the M.S. and Ph.D. programs that are intended to provide some breadth in the student's program. Each student is expected to participate in the graduate seminar course and in field work or an oceanographic cruise.

During the past year one Ph.D. and three M.S. degrees were granted by the Department.

The student will normally take most of his coursework from those offered by the Department. However, courses that are of interest to our students are also offered by the Departments of Civil Engineering, Geosciences, Mechanical and Aerospace Engineering and Zoology.

The following courses are offered in conjunction with the above programs:

MSE 200	Introduction to Marine Environment	3
MSE 511	Laboratory and Field Methods for Investigation of the Seabed	3
MSE 526	Air-Sea Interaction	3
MSE 529	Biological Oceanography	3
MSE 541	Gravity Waves	3
MSE 551	Ocean Circulation	3
MSE 560	Principles of Physical Oceanography	3
MSE 561	Introduction to Physical Oceanography	3
MSE 563	Geophysical Fluid Mechanics	3
MSE 565	The Physical Dynamics of Estuaries	3
MSE 571	Principles of Chemical Oceanography	3
MSE 581	Behavior and Analysis of Ocean Structures	3
MSE 582	Coastal Hydrodynamics	3
MSE 583	Engineering Aspects of Coastal Processes	3
MSE 584	Marine Geology	3
MSE 591, 592	Marine Science and Engineering Seminar	1
MSE 610	Marine Sedimentology	3
MSE 611	Continental Margin Sedimentation	3
MSE 663	Advanced Geophysical Fluid Mechanics	3
MSE 664, 665	Perturbation Methods in Fluid Mechanics, I, II	3
MSE 673	Marine Geochemistry	3
MSE 675	The Use of Radiochemical and Stable Isotopes in Marine Studies	3
MSE 685	Design of Coastal Facilities	3
MSE 687	Numerical Modeling for Nearshore Flow Systems	3
MSE 693	Special Topics in the Marine Sciences	1-3

The instructional staff for the courses listed above consists of the following:

DEPARTMENTAL FACULTY

Curtin, T.B., M.S., Instructor
DeMaster, D.J., Ph.D., Assistant Professor
Janowitz, G.S., Ph.D., Associate Professor

Kamykowski, D., Ph.D., Associate Professor
Knowles, C.E., Ph.D., Associate Professor
Langfelder, Jay, Ph.D., Professor and Department Head
Machemehl, J.L., Ph.D., Associate Professor
Nittrouer, C.A., Ph.D., Assistant Professor
Pietrafesa, L.J., Ph.D., Associate Professor
Rogers, S.M., Jr., M.S., Extention Specialist
Tayfun, M.A., Ph.D., Associate Professor
Weisberg, R.H., Ph.D., Assistant Professor
Wolcott, T.G., Ph.D., Associate Professor

ASSOCIATED FACULTY

Amein, M., Ph.D., Professor of Civil Engineering
Arya, S.P.S., Ph.D., Associate Professor of Geosciences
Copeland, B.J., Ph.D., Professor of Zoology
Hassler, W.W., Ph.D., Professor of Zoology
Longmuir, I., M.D., Board Chairman, Professor of Biochemistry
Miller, J., Ph.D., Associate Professor of Zoology
Sorrell, F.Y., Ph.D., Professor of Mechanical and Aerospace Engineering
Tung, C.C., Ph.D., Professor of Civil Engineering

To obtain further information, address inquiries to:

Jay Langfelder, Head
Marine Science and Engineering
North Carolina State University
1204 Burlington Laboratory
Raleigh, North Carolina 27650
(919) 737-3326

NORTHEASTERN ILLINOIS UNIVERSITY
Chicago, Illinois 60625

Northeastern Illinois University offers an interdisciplinary program in limnology and the marine sciences. The principal teaching and research center is located on the university campus approximately four miles from Lake Michigan. Because of the proximity, size and regional importance of the lake, a number of year-round projects are being pursued in this area. Facilities at the University include a small research vessel, water and sediment sampling gear, underwater photography equipment, a complete sediment analysis lab (including x-ray fluorescence and x-ray diffraction), three large laboratory-lecture rooms, a photography lab, a weather facsimile recorder and a seismology lab. In addition, the Department of Earth Science sponsors an Environmental Quality Institute which has available a water analysis lab (including an atomic absorption spectrophotometer). Coastal oceanography courses and research projects are run during the summer at field camps on the Atlantic and Gulf coasts and on Lake Michigan at the main campus.

The undergraduate students interested in oceanography may follow a program leading to a Bachelors degree in the earth sciences, geography and environmental studies, or the Kaskaskia Plan, with a concentration in oceanography. The Kaskaskia Plan for Individualized Curricula, allows the undergraduate to plan his/her total academic career using the facilities available at Northeastern and thus would be particularly useful to the student interested in oceanography. Graduate students may obtain a Masters degree in geography and environmental studies or earth sciences with a concentration in oceanography.

1. B.S. in Earth Sciences. Three semester hours in each of the following areas: geology, meteorology, oceanography and one field course; 18 semester hours in earth science electives; and 15 hours in other natural sciences and mathematics.

2. M.S. in Earth Sciences. Thirty semester hours in graduate Earth Science courses and a total of at least 45 semester hours of combined graduate and undergraduate level earth science credit. A thesis is required.

3. B.A. in Geography and Environmental Studies. Nine semester hours in each of the following areas: physical geography, human geography and six hours in regional geography and three of the nine hours of physical geography may be taken in marine science courses.

4. M.A. in Geography and Environmental Studies. The requirements include 33 hours in geography and environmental studies (six hours of which may be taken for thesis credit). Three courses (three credits each) are required: cartography, statistics for earth sciences and geography, and scope of philosophy of the geographical sciences. The remaining 18 hours may be taken in marine science courses, and the program must be organized systematically under the guidance of the faculty advisor.

5. Kaskaskia B.A. Experimental Plan/Marine Sciences. The requirements stipulate that the student plan his/her total four year curriculum in conjunction with a University advisor and an outside advisor. This would allow a strong concentration in the physical sciences.

The following courses are offered in conjunction with the above programs. 100 or 200 level courses are designated "undergraduate", 300 or 400 level courses are designated "graduate".

G&ES 351	Statistics for Earth Science and Geography	3
G&ES 352	Independent Study in Geography	3
G&ES 371	Geomorphology	3
G&ES 375	Regional Climatology	4
G&ES 378	Physical Climatology	3
G&ES 379	Seminar: Fluvial Processes	3
G&ES 421	Seminar: Climatological Problems	4
G&ES 373	Biological Geography	3
G&ES 442	Geographic Problems in Quantitative Measurements	3
G&ES 431	Thesis Seminar	6
G&ES 441	Mathematical Geography	3
ESCI 309	Geochemistry	3
ESCI 335	Meteorology I	4
ESCI 336	Meteorology II	4
ESCI 317	Principles of Sedimentation	4
ESCI 318	World Regional Geology	3
ESCI 323	Field Geology	4
ESCI 324	Oceanography I	3
ESCI 325	Oceanography II	3
ESCI 334	Coastal Marine Research	4

ESCI 326	Individual Study in Earth Science	3
ESCI 328	Marine Geology	3
ESCI 320	Limnology	3
ESCI 325A	Limnological Methods	3
ESCI 319	Petrology	3
ESCI 415	Plate Tectonics	3
ESCI 325	Seminar: Environmental Stability in Lake Michigan	3
ESCI 205	Water Resources in Urban Environment	3
ESCI 407	Hydrogeology	3
ESCI 413	Atmospheric Science	3
ESCI 414	Thesis Seminar: Earth Science	6
BIO 317	Ecology	3
BIO 326	Biological Geography	3
BOT 316	Algology	3
ZOOL 315	Invertebrate Zoology	3

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Betz, Robert F., Ph.D., Professor
Lamp, Herbert, Ph.D., Professor and Chairman

EARTH SCIENCE

Charlier, Roger H., Ph.D., Professor
Doehler, Robert W., Ph.D., Professor
Forslev, Albert W., Ph.D., Professor
Shabica, Charles W., Ph.D., Associate Profess
Sood, Mohan K., Ph.D., Professor and Chairman
Upadhyay, Hansa D., Ph.D., Associate Professor

GEOGRAPHY AND ENVIRONMENTAL STUDIES

Millard, William, Ph.D., Assistant Professor
Winston, Barbara, Ph.D., Associate Professor and Chairman

To obtain further information, address inquiries to:

Dr. Charles W. Shabica
Department of Earth Science
Northeastern Illinois University
Bryn Mawr At St. Louis Avenues
Chicago, Illinois 60625

NORTHEASTERN UNIVERSITY
Boston, Massachusetts 02115

Northeastern University has a marine research institute on a 20-acre site on the shoreline at Nahant, Massachusetts. The marine facility is being utilized by faculty and graduate students for research in areas of biological oceanography, earth science and ocean engineering.

No degrees are offered in oceanography at present, but undergraduates can major in earth science and all students may receive oceanographic background on cooperative jobs at marine-oriented corporations and firms. Advanced degrees incorporating marine research thesis problems are developed in biology, chemistry, and engineering.

The following courses in Marine Science are offered:

12.180 Ocean Chemistry 4

Principles and practices of chemical and instrumental methods in current use in marine investigations, with emphasis on procedures, apparatus, and interpretation of experimental observations. Laboratory. Prerequisites 12.105, 12.171, or equivalent.

16.131 Oceanography I 4

The geology of the ocean basins; the physical and chemical properties of sea water; the development of ocean currents and their important effects on the land masses of the world.

16.132 Oceanography II 4

The productivity of animal and plant life in the various zones of the ocean; the growing economic importance of the oceans as a source of food for the expanding world population.

16.233 Coastal Processes 4

The effect of nearshore marine processes and the resultant coastal responses. The dynamics of waves and currents and the associated erosion, transportation, and deposition of sediment forming beaches, barrier islands, and cliffed structures. Prerequisite: 16.201.

16.531 Oceanography I 2

Introduction to the origin of the global ocean and the physical and chemical properties of sea water. Development of ocean currents and their effect on the land masses of the world. Problems of ocean pollution are examined. Prerequisite: 16.503 or equivalent.

16.532 Oceanography II 2

The habitat zones and organisms of the sea. Phytoplankton, zooplankton and nekton are discussed. The growing economic importance of marine resources for the expanding world population. Prerequisite: 16.531 or equivalent.

16.533 Marine Geology 2

Physiography and structure of ocean basins. Marine geological processes and features including sedimentation, erosion, shorelines, and bottom topography. Methods and techniques of marine geological exploration. Prerequisite: 16.503 or equivalent.

16.534 Fisheries Oceanography I 2

Survey of commercially important marine organisms. An introduction to life histories and distribution of commercially important seaweed, shellfish, and fishes. Population dynamics and fishery potential of the world's oceans. An analysis of fishery stocks and sea farming. Prerequisite: 16.503 or equivalent.

16.535 Fisheries Oceanography II 2

Examination of fishery methods and techniques around the world in the light of recent technological advancement. Prerequisite: 16.534 or equivalent.

16.536 Fisheries Oceanography III 2

A study of the commercial products and applications of marine organisms such as sea weed, fish, and shellfish. Particular emphasis on the marine products of commerce from the New England area. Chemical, industrial, and dietary applications of marine products. Prerequisite: 16.535 or equivalent.

18.810 Ichthyology

Natural history and systematics of fishes, with emphasis on marine species (Marine Science Institute).

18.815 Biological Factors in Ocean Engineering 2

Natural biological phenomena and their relationship with man-made alterations of the sea. Prerequisite: Registration in a graduate engineering program.

18.818 Ecology of Salt Marshes 3

Survey of fauna and flora, environmental factors affecting them and current biological and social problems associated with this habitat. This course will meet for two lectures of one and one-half hours each and one full day of laboratory for six weeks during the summer quarter. Prerequisite: A basic ecology course or consent of the instructor.

18.830 Marine Algae

Systematics, life histories, and ecology of marine algae, with emphasis on the flora of the Gulf of Maine (Marine Science Institute).

To obtain further information, address inquiries to:

Nathan W. Riser, Ph.D., Director
Northeastern University Marine Institute
Northeastern University
360 Huntington Avenue
Boston, Massachusetts 02115

or,

Director of Admissions
Northeastern University
360 Huntington Avenue
Boston, Massachusetts 02115

THE OHIO STATE UNIVERSITY
Columbus, Ohio 43210

The Ohio State University maintains teaching and research facilities in the marine and aquatic sciences and related fields at the Franz Theodore Stone Laboratory on Gibraltar Island in Lake Erie and at the main campus of the University in Columbus. The research activities in marine and aquatic sciences and related fields are coordinated through the University's Center for Lake Erie Area Research (CLEAR) with laboratories and offices at Port Clinton, Put-in-Bay, and Sandusky, Ohio, on South Bass Island in Lake Erie, and the Columbus campus.

The principal teaching facilities for aquatic sciences are located on Gilbraltar Island overlooking Put-in-Bay Harbor. These facilities provide ample laboratory, classroom, and office space for the summer teaching program. The equipment supply for the program is extensive; in addition to the usual modern laboratory equipment, two large lake vessels and numerous outboard and manually propelled small boats are available. The island library provides a valuable study tool containing books, periodicals, and reprints related to all categories of aquatic science. Dormitories for students, housing for faculty and a University-operated eating facility are a part of the physical plant.

Degrees offered with emphasis in marine or aquatic sciences:

1. B.S. and B.A. The student, together with his/her advisor may design a baccalaureate program in one of several disciplines with emphasis on aquatic science and a balanced academic background for graduate study in marine science. The general requirements for a baccalaureate degree are:

a) Not less than 40 quarter hours in the chosen major area
b) Fifteen quarter hours in each of the three basic areas of academic study: the humanities, the social sciences, and the natural sciences
c) English, a foreign language, mathematics and/or philosophy and history.
d) A total minimum of 180 quarter hours.

The baccalaureate degree with emphasis in and/or preparation for advanced aquatic studies may be taken in the following areas: Biochemistry, Biology, Botany, Entomology, Genetics, Microbiology, Zoology, Natural Resources, Anthropology, Geology, Civil Engineering, Chemical Engineering, and Mathematics and Science Education.

2. Master's Degree. The Master of Science degree may be earned in each of the above disciplines, plus Environmental Biology, Developmental Biology, and Biophysics.

The general requirements for the M.S. degrees as stipulated by the Graduate School of The Ohio State University are: completion of a minimum of 45 hours of graduate coursework within six calendar years with a cumulative point-hour ratio of 3.0 (of 4.0) in all courses taken for graduate credit; successful completion of a final comprehensive examination; an approved thesis.

Certain of the academic areas listed above provide an alternate M.S. degree program without thesis but with more extensive graduate course requirements.

3. Doctor of Philosophy Degree. The Doctor of Philosophy degree may be earned in all academic areas listed above as offering the M.S. degree except Natural Resources. The general requirements for the Doctor of Philosophy Degree are:

a) Completion of a minimum of 135 quarter hours of graduate coursework (including credit for dissertation research) beyond the baccalaureate degree, with cumulative point-hour ratio of at least 3.0 (of 4.0).

b) A period of concentrated graduate study beyond the master's degree, at the Columbus Campus, during three of four consecutive quarters with at least 10 graduate credit hours a quarter.

c) Successful completion of a general comprehensive examination no later than two quarters prior to the date on which the candidate expects to receive the degree.

d) Presentation of an acceptable dissertation embodying the results of an original investigation.

e) The passing of a final oral examination on the dissertation and on the immediate field of investigation.

Biological Sciences undergraduate/graduate courses with primary emphasis on aquatic systems. (Numerous additional courses offered by many departments of the University contribute in part or are applicable to an understanding of aquatic and marine science.)

Botany 313	Introduction to Ecology
Botany 610	Field Botany
Botany 611	Higher Aquatic Plants
Botany 632	Physiological Ecology of Plants (Aquatic Emphasis)
Botany 644	Algae
Botany 647	Plankton
Botany 663	Aquatic Mycology
Botany 802	Seminar in Environmental Botany
Botany 891	Interdepartmental Seminar in Environmental Biology
Botany 897	Interdepartmental Seminar in Natural Resources
Entomology 531	Pesticides, the Environment, and Society
Entomology 532	Pesticides Regulations
Entomology 611	Field Entomology
Entomology 612	Aquatic Entomology
Entomology 661	Medical Entomology
Entomology 662	Principles of Insect Toxicology
Entomology 7[illegible]	Immature Insects
Entomology 891	Interdepartmental Seminar in Environmental Biology
Microbiology 301	Biology of Pollution
Microbiology 509	Microbiology in Relation to Man
Microbiology 601	General Microbiology
Microbiology 602	General Microbiology Laboratory
Microbiology 629	Pathogenic Protozoology
Microbiology 634	Water Microbiology
Microbiology 639	Aquatic Microbiology
Microbiology 662	Physiology and Ecology of Aquatic Microorganisms
Microbiology 891	Interdepartmental Seminar in Environmental Biology
Microbiology 897	Interdepartmental Seminar in Natural Resources
Zoology 211	Invertebrate Zoology
Zoology 313	Introduction to Ecology
Zoology 320	Introduction to Biology of the Sea
Zoology 611	Animal Parasitology
Zoology 612	Invertebrate Zoology
Zoology 620	Vertebrate Zoology
Zoology 621	Ichthyology
Zoology 622	Herpetology
Zoology 624	Advanced Ornithology
Zoology 626	Biology of Fishes
Zoology 647	Plankton
Zoology 650	Animal Ecology
Zoology 651	Field Zoology
Zoology 652	Limnology
Zoology 653	Fish Ecology
Zoology 654	Physiology of Aquatic Animals
Zoology 655	Limnology
Zoology 660	Fisheries Biology
Zoology 665	Research Techniques in Fishery Biology
Zoology 666	Radiation Measurements in Aquatic Systems
Zoology 710	Fish and Wildlife Parasitology
Zoology 714	Environmental Pollution Abatement
Zoology 721	Marine Biology Seminar
Zoology 811	Advanced Invertebrate Zoology
Zoology 812	Advanced Invertebrate Zoology

Individual Studies 693 in all disciplines listed above as offering degrees in aquatic-related areas.

Research 999 in all disciplines listed as offering degrees in aquatic-related areas.

The research unit of the aquatic and marine program at The Ohio State University is the Center for Lake Erie Area Research (CLEAR) which maintains laboratories and offices in Columbus, Port Clinton, Put-in-Bay, and Sandusky. CLEAR serves the University as a focal point for action directed toward solutions of scientific and engineering problems of the lake as well as societal and economic conditions of the adjacent coastal zone. CLEAR's objective is to encourage and promote individual and multidisciplinary research on all aspects of Lake Erie and its environs. The Center coordinates sponsored research in several major areas of man's concern, contemporary examples of which are:

1. Food resources from the lake;
2. Impact of the energy crisis;
3. Coastal zone management and erosion control; and
4. Pollution and eutrophication.

The research phase of the Lake Erie Program is closely linked to instruction by providing students with financial support and stimulating topics for theses, dissertations, and other individual study efforts. CLEAR also serves as an inter-university coordination center for faculty and students from other area institutions with common interests in Lake Erie and marine studies.

Public service efforts are jointly sponsored by the instructional and research units. These services include special interest courses, conferences, seminars, workshops, publications, and advisory assistance to groups and individuals on a wide range of subjects related to Lake Erie. Advisory services are coordinated through the Ohio Sea Grant Program.

Current (1979-1980) research projects dealing with aquatic/marine subjects:

1. Bilateral Asymmetry in Freshwater Fishes as an Index of Environmental Contamination

2. Biological Evaluation of Stream Improvement and Structures in the Chippewa Creek Watershed Protection and Flood Prevention Project
3. Commercial Fishing: Gear Mortality
4. Comparative Cytology and Biochemistry of Selected Green Algae
5. Environmental Evaluation of a Nuclear Power Plant on Lake Erie
6. Environmental History of Toolik Lake and Toolik Drainage
7. Experimental Analysis of a Predator-Prey System (redear sunfish-benthic molluscs)
8. Great Blue Herons as Environmental Indicators
9. Inhibition of Microbiological Acid Production in Coal Mine Refuse and Strip Mine Spoils
10. Impact of the Nematode Parasite *Eustrongylides tubifex* on Yellow Perch in Lake Erie
11. Investigation of Mortality of Lake Trout Stocked by Airplanes
12. Lake Erie Nearshore Surveillance Program (Western Basin)
13. Limnological Investigations of Water Quality and Fish Larvae in Lake Erie
14. Monograph of the Saprolegniaceae
15. Ohio Sea Grant Program: (1) Administration; (2) Extension; (3) Marketing Freshwater Drum and Other Under-Utilized Species
16. Operational Aquatic Monitoring Program for the Davis-Besse Nuclear Power Station
17. Organochlorine Contaminant Levels in Edible and Inedible Portions of Selected Lake Erie Fishes
18. Physiology of Buoyancy Regulation
19. Productivity of Great Lake Zooplankton
20. Resource Patterns and the Structure of Social Systems (Mottled Sculpin, *Cottus bairdi*)
21. A Shoreline Inventory of the Lake Erie Shoreline and Selected Research of Navigable Rivers in the State of Ohio
22. Study to Determine the Cause and Conditions of Green Water in Wastewater Treatment Basins
23. Summary of Knowledge of the Fish and Wildlife Resources of the Coastal Wetlands of the Great Lakes of the United States
24. Transport Properties of the Great Lakes Seiche-Affected River Mouths

The OSU instructional and research faculty for aquatic and marine degree and research programs listed are:

Baby, Raymond S., Adjunct Professor, Anthropology
Bates, Robert L., Professor Emeritus, Geology
Baumann, Paul C., Adjunct Assistant Professor, Zoology
Bedford, Keith, Associate Professor, Civil Engineering
Berra, Tim M., Associate Professor, Zoology
Bookhout, Theodore A., Adjunct Professor, Zoology
Britt, N. Wilson, Professor, Entomology
Carey, Walter E., Associate Professor, Zoology and Nuclear Engineering
Carline, Robert F., Adjunct Assistant Professor, Zoology
Cavender, Ted M., Associate Professor, Zoology
Colinvaux, Paul A., Professor, Zoology
Cook, Clayton B., Assistant Professor, Zoology
Cook, Susan K., Adjunct Assistant Professor, Zoology
Crites, John L., Professor, Zoology
Culver, David A., Assistant Professor, Zoology
Downhower, Jerry F., Associate Professor, Zoology
Dugan, Patrick R., Professor, Microbiology
Floyd, Gary L., Associate Professor, Botany
Frea, James I., Professor, Microbiology
Grau, Gerald A., Adjunct Assistant Professor, Zoology
Greenwald, Lewis, Associate Professor, Zoology
Griswold, Bernard L., Adjunct Associate Professor, Zoology
Herdendorf, Charles E., Professor, Zoology
Johnson, David L., Assistant Professor, Natural Resources
King, Charles C., Director, Ohio Biological Survey
Lustick, Sheldon I., Professor, Zoology
McKenzie, Gary D., Associate Professor, Geology
Mintzer, Olin W., Professor, Civil Engineering
Moore, Charles A., Professor, Civil Engineering
Peterle, Tony J., Professor, Zoology
Pfister, Robert M., Professor, Microbiology
Putnam, Loren C., Professor, Zoology
Randles, Chester I., Professor, Microbiology
Reutter, Jeffrey M., Adjunct Assistant Professor, Zoology
Ricca, Vincent T., Professor, Civil Engineering
Ross, Robert T., Associate Professor, Biochemistry
Seymour, Roland L., Associate Professor, Botany
Smith, Kenneth R., Associate Professor, Zoology
Snyder, Roy E., Assistant Professor, Botany
Stansbery, David H., Professor, Zoology
Stein, Roy A., Assistant Professor, Zoology
Stiefel, Robert C., Professor, Civil Engineering
St. John, F. Lee, Assistant Professor, Zoology
Stuckey, Ronald L., Professor, Botany
Svanks, Karlis, Associate Professor Emeritus, Chemical Engineering
Sykes, Robert M., Associate Professor, Civil Engineering
Taft, Clarence E., Professor Emeritus, Botany
Tassava, Roy A., Professor, Zoology
Valentine, Barry D., Professor, Zoology
Whitlatch, Elbert E., Assistant Professor, Civil Engineering
Zapatosky, John E., Adjunct Assistant Professor, Zoology

To obtain further information, address inquiries to:

Dr. Charles E. Herdendorf, Director
Center for Lake Erie Area Research
The Ohio State University
484 West 12th Avenue
Columbus, Ohio 43210

or,

Dr. Richard O. Moore, Associate Dean
College of Biological Sciences
The Ohio State University
484 West 12th Avenue
Columbus, Ohio 43210

OLD DOMINION UNIVERSITY
Norfolk, Virginia 23508

INSTITUTE OF OCEANOGRAPHY

The institute occupies a 20,000 square foot building on the campus of Old Dominion University with eight laboratories for biological, chemical, geological, and physical oceanography. An additional marine culture building is located across campus and houses equipment for holding and culturing fish, macroinvertebrates, and plankton. The Institute's research laboratories are extensively equipped for work in all disciplines of oceanography. A large radiogeochemistry lab supports research involving radioisotopes. A computer terminal is located in the building. The Institute maintains docking facilities at the Naval Amphibious Base at Little Creek, Norfolk, Virginia. A 65-foot former Army T-boat, R/V Lindwood Holton, has been converted for use in coastal and estuarine studies. The vessel contains oceanographic winches, a crane, sampling equipment, and laboratory facilities. Smaller vessels are also operated by the Institute. Investigators with requirements for larger vessels have access to those of nearby institutions.

Master of Science degrees in oceanography are offered with the choice of emphasis in physical oceanography, chemical oceanography, geological oceanography, and biological oceanography. In order to qualify for a degree of Master of Science with a concentration in oceanography, a student must meet the following general requirements.

1. He or she must have satisfied the various degree requirements established by the University and state in the graduate catalogue.

2. The student must satisfactorily complete either a thesis program consisting of 32 semester hours of graduate study or a non-thesis program consisting of 38 semester hours of graduate study. The student's program must conform to the following outline:

a) Fifteen hours of basic coursework is required. This core program consists of Physical Oceanography (OC 604-605); Chemical Oceanography (OC 610); Geological Oceanography (OC 620); and Biological Oceanography (OC 640).

b) Participation in Institute seminars for a minimum of two semesters is required of each degree candidate.

c) Three hours of research is required. No more than three credit hours of research may be applied to the semester hour requirement for the master's degree.

d) Three hours of thesis is required. No more than three credit hours of thesis may be applied to the semester hour requirement for the master's degree. (Not required for the nonthesis program.)

e) Each student under the thesis program is required to take at least three additional courses at the 600 level selected from an approved list.

f) Each student under the nonthesis program is required to take at least six additional courses at the 600 level selected from an approved list.

In order to qualify for the degree of Ph.D. in Oceanography, a student must pass a diagnostic examination during the first semester, a comprehensive examination at the completion of coursework, and a defense of the dissertation. Twenty-four credits of post-MS coursework are required and 24 credit hours or more of dissertation work. Students who are very well qualified may be offered the option of by-passing the MS degree and entering the Ph.D. program after completion of at least 18 credit hours of MS-level work.

Two Ph.D. degrees were granted during 1979.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE/GRADUATE COURSES

106	Introductory Oceanography	4
107	Introductory Oceanography	4
120	Small Craft Navigation	1
121	Seamanship for Oceanographers	1
195	Topics in Oceanography	1-3
196	Topics in Oceanography	1-3
401	The Seaport as a System	3
406	Oceanography	3
413	Oceanography of Seaports	3
491	Problem-Solving in Seaport Systems	3
497	Special Topics in Oceanography for non-Science Majors	1-4
601	Oceanographic Analysis	3
604	Physical Oceanography	3
605	Physical Oceanography	3
607	Theory of Waves	3
608	Underwater Sound	3
610	Chemical Oceanography	3
611	Chemical Oceanography Laboratory	2
612	Advanced Chemical Oceanography	3
614	Environmental Chemistry of the Oceans and Coastal Zones	3
617	Theory of Tides	3
620	Geological Oceanography	3
625	Dynamics of Marine Sedimentation	3
626	Beaches and Shallow Water Processes I	3
628	Marine Sediments	3
630	Dynamical Oceanography I	3
631	Marine Geophysics	3
640	Biological Oceanography	3
641	Marine Phycology	3
642	Marine Microbial Ecology	3
643	Physiology of Marine Plants	3
644	Environmental Physiology of Marine Invertebrates	3
645	Crustacea in the Marine Environment	4
646	Sea Farming	3
660	Environmental Control in the Ocean	3
670	Wave and Tidal Dynamics in Estuaries, Bays and Harbors	3
671	Estuary Dynamics	3
691	Seminar	1
692	Seminar	1
693	Special Topics in Oceanography	3
698	Research	1-9
699	Thesis	1-9
707	Statistical Wave Theory	3

709	Optical Oceanography	3
710	Thermal Processes in the Ocean	3
712	Radiogeochemistry of the Ocean	3
714	Biological-Chemical Interactions in the Oceans	3
716	The Ocean as a Chemical System	3
718	Organic Geochemistry of the Oceans	3
720	Ocean Boundary Layer Problems	3
725	Remote Sensing of Off-Shore Waters and Estuaries	3
726	Beaches and Shallow Water Processes II	3
730	Dynamical Oceanography II	3
732	Geochemistry of the Oceans	3
747	Reproduction of Marine Invertebrates	4
748	Plankton Population Dynamics I	4
749	Plankton Population Dynamics II	4
755	Advanced Studies in Phytoplankton Biology	2
756	Advanced Studies in Zooplankton Biology	2
760	Contemporary Problems in Biological Oceanography	3
798	Research	1-9
799	Dissertation	1-9

Under special circumstances, elective courses available in other departments as listed below may be substituted for certain of the 500-level oceanography courses required of master's degree candidates.

DEPARTMENT OF GEOPHYSICAL SCIENCES

516 Paleoecology
517 Geochemistry
525 Coastal Plain Geology
532 Sedimentary Petrology
534 Introduction to Geophysics
535 Micropaleontology
548 Physical Meteorology
561 Dynamic Meteorology I
562 Dynamic Meteorology II
624 Dynamics of the Marine Atmosphere
667 Atmospheric Transport and Diffusion

DEPARTMENT OF PHYSICS

661 Principles of Atmospheric Physics
666 Special Topics in Environmental and Space Physics

DEPARTMENT OF CIVIL ENGINEERING

640 Hydromechanics
641 Open Channel Hydraulics
643 Water Resources Systems Engineering
644 Case Study in Hydraulics and Water Resources
645 Hydromechanics of Mass Transport Processes in Open Water Systems
741 Sediment Transport Mechanics
742 Scaled Models in Water Resources
743 Advanced Mathematical Modeling in Water Resources
744 Advanced Water Resources Systems

DEPARTMENT OF BIOLOGICAL SCIENCES

516 Mycology
517 Limnology
518 Aquatic and Wetlands Plants
519 Marine Plankton
520 Ichthyology
569 Marine Microbiology
622 Arthropods of Marshes and Estuaries
623 Advanced Ichthyology
650 Marine Benthic Ecology

DEPARTMENT OF CHEMICAL SCIENCES

611 Principles of Chemical Instrumentation Lecture I
612 Principles of Chemical Instrumentation Laboratory I
613 Principles of Chemical Instrumentation Lecture II
614 Principles of Chemical Instrumentation Laboratory II

The instructional staff for the courses listed above consists of the following:

Grosch, Chester E., Ph.D., Samuel L. and Fay M. Slover Professor of Oceanography
Johnson, Ronald E., Ph.D., Graduate Program Director and Associate Professor of Oceanography
Ludwick, John C., Ph.D., Director of the Institute of Oceanography and Samuel L. and Fay M. Slover Professor of Oceanography
Oertel, George F., Ph.D., Associate Professor of Oceanography
Ofelt, George S., Ph.D., Associate Professor of Oceanography
Provenzano, Anthony J., Ph.D., Professor of Oceanography
Wade, Terry L., Ph.D., Assistant Professor of Oceanography
White, Harris H., Ph.D., Assistant Professor of Oceanography
Wong, George T.F., Ph.D., Assistant Professor of Oceanography

JOINT APPOINTEES

Alden, Raymond W., III, Ph.D., Assistant Professor of Biological Sciences and Oceanography
Bell, Charles E., Jr., Ph.D., Professor of Chemical Sciences and Oceanography
Birdsong, Ray S., Ph.D., Associate Professor of Biological Sciences and Oceanography
Blair, Carvel H., Ph.D., Assistant Professor of Mathematics and Oceanography
Darby, Dennis A., Ph.D., Chairman of the Department of Geophysical Sciences and Associate Professor of Geophysical Sciences and Oceanography
Dauer, Daniel M., Ph.D., Assistant Professor of Biological Sciences and Oceanography
Kindle, Earl C., Ph.D., Professor of Geophysical Sciences and Oceanography
Kuo, Chin Y., Ph.D., Associate Professor of Engineering and Oceanography

To obtain further information, address inquiries to:

Dean of Graduate Studies
Old Dominion University
Norfolk, Virginia 23508
(804) 489-6000, ext. 6661

DEPARTMENT OF BIOLOGICAL SCIENCES

The Department of Biological Sciences offers a wide-based marine curricula on the undergraduate and graduate levels. Having a full-time faculty of 34 and areas of major development in ecological sciences, microbiology and biomedical sciences, a significant portion of the department's orientation is in marine biology. A new Life Science building is under construction and will house five laboratories assigned to marine courses and research. A special water pollution laboratory is already in operation, with the new building having specialty rooms for an existing herbarium collection of wetlands and aquatic plants, an aquatic animal and culture laboratory, and a research vertebrate museum for animals of the coastal plain. Other departmental facilities include an electron microscope laboratory, an animal holding and research facility, greenhouse, and a biology laboratory support facility for culture and media prep needs. Field equipment includes four fiberglassed hulled skiffs, with outboard motors and an array of collection gear. The Department also operates a fully equipped mobile field laboratory, two departmental vans, and a service truck for travel needs. Two field stations are presently under various stages of development; one functions in the Barrier Island complex, the other is in the Great Dismal Swamp. In addition, the Department is actively involved in an interdisciplinary campus program on Seaport Systems Management.

Under the B.S. in Biology program, students may take a concentration in Marine Biology courses which would include approximately 20 semester hours.

Under the Master of Science degree a concentration in Marine Biology may be obtained. The student may select from a thesis (31 hours) or non-thesis (34 hours) track. Course selection is determined by the recommendations of the student's advisory committee which would usually include a majority of marine biology courses.

Presently the only doctorate awarded through the Department is a Ph.D. in Biomedical Sciences. In addition to the marine biology courses are numerous supportive selection in invertebrate zoology, animal physiology, ornithology, and various ecological areas.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE/GRADUATE COURSES

Biology 415/515	Marine Ecology	4
Biology 418/518	Aquatic and Wetland Plants	4
Biology 419/519	Marine Plankton	4
Biology 420/520	Ichthyology	4
Biology 430/530	Marine Science	4
Biology 437/537	The Seaport Ecosystem	3
Biology 443/543	Marine Science Field Studies	4
Biology 469/569	Marine Microbiology	4
Biology 470/570	Pollution Ecology	4

GRADUATE COURSES

Biology 622	Arthropods of Marshes and Estuaries	4
Biology 623	Advanced Ichthyology	3
Biology 624	Fisheries Biology	3
Biology 628	Ecosystems Models and Systems Analysis	5
Biology 635	Coastal Ecological Systems of the U.S.	3
Biology 636	Marine Zooplankton	3
Biology 637	Marine Phytoplankton	3
Biology 649	Zoogeography	3
Biology 650	Marine Benthic Ecology	4
Biology 698	Research	3
Biology 699	Thesis	3

Of the Department's 34 faculty members, the following are directly involved in both the marine biology course offerings and research activities.

Alden, Raymond W., Ph.D., Assistant Professor of Biological Sciences and Oceanography
Birdsong, Ray S., Ph.D., Associate Professor of Biological Sciences and Oceanography
Dauer, Daniel M., Ph.D., Assistant Professor of Biological Sciences and Oceanography
Erkenbrecher, C.W., Ph.D., Assistant Professor of Biological Sciences
Johnson, James C., Ph.D., Assistant Professor of Biological Sciences
Kirk, Paul W., Ph.D., Professor of Biological Sciences
Marshall, Harold G., Ph.D., Professor of Biological Sciences and Oceanography
Musselman, Lytton J., Ph.D., Associate Professor of Biological Sciences

JOINT APPOINTMENTS

Provenzano, A.J., Jr., Ph.D., Slover Professor of Oceanography
Rule, Joseph H., Ph.D., Assistant Professor of Geophysical Sciences

To obtain further information, address inquiries to:

Chairman or the Graduate Program Director
Department of Biological Sciences
Old Dominion University
Norfolk, Virginia 23508

ORANGE COAST COLLEGE
Costa Mesa, California 92626

The Marine Science Department was formed in the Fall of 1968, with a working complement of one instructor, very little hardware, and three potential marine technicians formally enrolled in a new and experimental two-year curriculum. In May of 1971, the expanding department moved to new quarters in the recently completed Center for Applied Science. Equipment currently available for training includes a 10,000 gallon circulating marine aquarium system for display and speciment storage, a "wet" marine laboratory with cold-room capability, equipment such as spectrophotometers, pH meters, oxygen tension analyzers, water-immersion Nikon microscopes, dissection microscopes and optics; Questar optical system for long-range study, telemicroscopy, telephotography and navigation, Gilson differential respirometer, absorption spectrometer, gas chromatograph, on-line computing capability with the College's IBM System/370, two 16-foot Boston Whalers and two 23-foot SeaCraft inboard-outboard vessels for field work, dredges, water sampling equipment, instruments for lab and field use in the measurement of physical parameters such as salinity, pH, conductivity, trace elements, etc. Other equipment is planned or available on loan from other College departments on a part-time basis. The Department also purchases time on large, ocean-going research vessels when appropriate.

Degree Offered: Associate in Arts, with specialization in Marine Technology.

The following required courses are listed below:

FOR DIRECT EMPLOYMENT AND ASSOCIATE DEGREE

Mar Sc	100	The Marine Sciences	3
Mar Sc	185	Ocean Resources	3
Mar Sc	210	Seamanship and Navigation	3
Mar Sc	280	Marine Biology	3
Mar Sc	285	Oceanographic Technology	4
Math	045	Inter Tech Math	3
Ind Arts	140	Electronics	3
Env Sci	140	Chemistry	4
Env Sci	240	Water Analysis	3
BIS	114	Basic Programming	1
Physics	110	Introductory Physics	3
English	105	Technical Report Writing	3
P.E.	110AD	Skindiving	1
P.E.	111AD	Scuba Diving	2

Plus one course from each of the following groupings:

Geol	100	Introductory Geology	3
Env Sci	100	Introductory Ecology	3
Bio	100	Introductory Biology	3
Ind Arts	150	Welding	3
Ind Arts	120	Drafting	2
Ind Arts	130	Machine Shop Practices	3

(Which of these courses the student takes will be determined by the student and his faculty advisor.)

It will also be necessary for the student to fulfill the Orange Coast College General Education requirements. The above program is, of course, approved for veterans.

The instructional staff of full-time faculty is as follows:

Garrison, Tom S., Ph.D., Assistant Professor of Marine Biology and Department Coordinator
Kelly, Dennis, M.A., Instructor in Marine Sciences
Low, Don R., M.S.T., Counselor
Reese, James I., M.S., Professor of Marine Sciences
Westgaard, Dean J., M.A., Associate Professor of Physical Education

To obtain further information, address inquiries to:

Dr. Tom Garrison
Department of Marine Sciences
Orange Coast College
2701 Fairview Road
Costa Mesa, California 92626
(714) 556-5647

OREGON STATE UNIVERSITY
Corvallis, Oregon 97330

SCHOOL OF OCEANOGRAPHY

The School of Oceanography during the last decade and a half has become a leader in oceanographic research and education, and ranks as one of the top university programs in the nation.

Coursework is offered on the main campus in Corvallis.

The Marine Science Center at Newport is used by several schools and departments at Oregon State University. The main building has offices and fresh and salt water laboratory space as well as a public auditorium, aquarium, and museum. Further details of the Marine Science Center in Newport are included below.

The School of Oceanography offers only graduate (M.S., M.A., and Ph.D.) degrees with majors in biological, chemical, geological, physical, and geophysical oceanography. A major in marine resource management is only offered at the Master's level.

Applicants must have an undergraduate major in an appropriate discipline with a minimum of one year each of university level chemistry, physics, and calculus. Selection of students is based on undergraduate record, graduate record examination (GRE) scores, and letters of recommendation.

All students majoring in oceanography or marine geophysics are expected to participate in work at sea during their graduate career.

1. M.A. or M.S. in Oceanography. A minimum of 45 hours including thesis work is required for the master's program. Approximately two-thirds of the work must be taken in the School of Oceanography. In special cases, the thesis requirement may be waived.

No foreign language is required for the M.S. degree. For the M.A. degree, the student must show, by examination or by adequate undergraduate courses (not less than two years), a reading knowledge of one foreign language, usually Russian, German, or French.

Candidates must pass a two-hour final oral examination including a thesis defense.

2. Ph.D. in Oceanography. Credits earned in the M.S. or M.A. program may be transferred into the Ph.D. program. Ph.D. candidates are required to have the equivalent of at least three years of full-time graduate work after receiving an undergraduate (B.S. or B.A.) degree. The credit hours in a program are determined by the student's doctoral committee (five or six members of the OSU graduate faculty). A foreign language is sometimes required. Normally one year is needed for thesis work. Candidates must pass a written departmental comprehensive examination (based on the oceanography courses), a university preliminary examination on the Ph.D. program, and a final oral thesis defense.

3. M.S., M.A., and Ph.D. in Geophysics. Programs in geophysics are offered within the School of Oceanography and in cooperation with the Departments of

Physics, Geology, and Mathematics. A student studying for a degree under this program works out a course of study upon consultation with his/her committee. This program must include a minimum of three courses in oceanography. Examination procedures and foreign language requirements are the same as for oceanography degrees.

4. M.A. or M.S. in Marine Resource Management. This program is designed to prepare students for careers in resource management and usually consists of basic courses in oceanography, economics, and business administration. Additional courses may be taken in the OSU Schools of Engineering and Agriculture and the Colleges of Science and Liberal Arts. Each program is adjusted to the needs of the individual. No thesis is required but an internship usually is.

The following courses are offered in conjunction with the above programs:

THE COURSES OF INSTRUCTION

All courses numbered 500-599 may be taken for graduate credit. Courses numbered 400-499 may be taken for graduate credit if designated (G) or (g). Those designated (g) may be used only as part of a minor. Oregon State University operates on the quarter system and credits are in quarter hours.

OCEANOGRAPHY COURSES

Oc	331	Introduction to Oceanography	3
Oc	405	Reading and Conference (g)	
Oc	406	Projects (g)	
Oc	407	Seminar (g)	
Oc	408	Workshop (g)	
Oc	431	Physical Oceanography (G)	3
Oc	432	Currents and Water Masses (G)	3
Oc	438	Underwater Acoustics (G)	3
Oc	442	Marine Zooplankton (G)	3
Oc	443	Marine Zooplankton Laboratory (G) (Oc 442 to be taken concurrently)	2
Mb	450	Marine Microbiology (G)	3
Oc	471	Physical Limnology (g)	3
Oc	490	Principles of Biological Oceanography (g)	3
Oc	491	Principles of Physical Oceanography (g)	3
Oc	492	Principles of Geological Oceanography (g)	3
Oc	493	Principles of Chemical Oceanography (g)	3
Oc	499	Special Topics in Oceanography (G)	1-5
Oc	501	Research	
Oc	503	Thesis	
Oc	505	Reading and Conference	
Oc	506	Projects	
Oc	507	Seminar	
Oc	508	Workshop	
Oc	510	Internship (for Marine Resource Management majors only)	1-9
Oc	511	Littoral Processes and Sedimentation	3
Oc	521	Marine Radioecology	3
Oc	529	Special Topics in Marine Radioecology	1-3
Oc	531	Descriptive Physical Oceanography I	3
Oc	532	Descriptive Physical Oceanography II	3
Oc	539	Regional Physical Oceanography	3
Oc	541	Biological Oceanography	4
Oc	542	Marine Nekton	3
Oc	543	Marine Nekton Laboratory (Oc 542 to be taken concurrently)	1
Oc	544	Marine Phytoplankton Ecology	3
Oc	545	Marine Phytoplankton Physiology	3
Oc	548	Marine Benthic Ecology	4
Oc	549	Special Topics in Biological Oceanography	1-3
Oc	551	Chemical Oceanography	3
Oc	552	Chemical Oceanography	3
Oc	553	Descriptive Chemical Oceanography	4
Oc	554	Theoretical Chemical Oceanography	4
Oc	555	Chemical Oceanography Laboratory	2
Oc	559	Special Topics in Chemical Oceanography	1-3
Oc	560	Geological Oceanography	4
Oc	561	Plate Tectonics and Structure of Ocean Basins	3
Oc	562	Sediment Transport and Continental Margin Sedimentation	3
Oc	563	Deep-Sea Sediments	3
Oc	564	Mineralogy of Marine Sediments	3
Oc	565	Stratigraphy of Marine Sediments	3
Oc	566	Isotopic Marine Geochemistry	3
Oc	567	Marine Micropaleontology I: Foraminifera	4
Oc	568	Marine Micropaleontology II: Radiolaria and Calcareous Nannoplankton	4
Oc	569	Special Topics in Geological Oceanography	1-3
Oc	571	Theoretical Physical Oceanography I	4
Oc	572	Theoretical Physical Oceanography II	4
Oc	573	Theoretical Physical Oceanography III	4
Oc	574	Theoretical Physical Oceanography IV	4
Oc	575	Theoretical Physical Oceanography V	4
Oc	578	Wave Dynamics	3
Oc	579	Special Topics in Physical Oceanography	1-3
Oc	581	Igneous and Metamorphic Processes in the Ocean Basins	2
Oc	582	Analysis of Geologic Data Bases (G)	4

GEOPHYSICS COURSES

Gph	501	Research	
Gph	503	Thesis	
Gph	505	Reading and Conference	
Gph	507	Seminar	
Gph	521	Planetology	3
Gph	528	Physics of the Earth	3
Gph	536	Theoretical Seismology	3
Gph	537	Earthquake Seismology	3
Gph	538	Applied Seismology	3
Gph	340	Geothermology	3
Gph	557	Paleomagnetism and Rock Magnetism	3
Gph	558	Geomagnetics	3
Gph	568	Earth's Gravity Field	3
Gph	570	Geoelectricity I	3
Gph	571	Geoelectricity II	3
Gph	587	Geophysical Time Sequence Analysis	3
Gph	589	Special Topics in Geophysics	1-3

The School of Oceanography faculty consists of the following:

Allen, John S., Ph.D., Associate Professor
Baross, John A., Ph.D., Research Associate
Beasley, Thomas M., Ph.D., Associate Professor
Bibee, Dale, Ph.D., Assistant Professor
Bodvarsson, Gunnar, Ph.D., Professor
Brink, Kenneth, Ph.D., Research Associate
Burt, Wayne V., Ph.D., D.Sc., Associate Dean
Caldwell, Douglas R., Ph.D., Professor
Carey, Andrew G., Jr., Ph.D., Associate Professor
Chen, Arthur, Ph.D., Assistant Professor

Condon, Edward J., M.S., Assistant Professor
Corliss, John B., Ph.D., Assistant Professor
Couch, Richard, Ph.D., Associate Professor
deSzoeke, Roland A., Ph.D., Assistant Professor
Dillon, Thomas M., Ph.D., Research Associate
Duncan, Robert A., Ph.D., Assistant Professor
Dymond, Jack, Ph.D., Professor
Enfield, Dave, Ph.D., Research Associate
Fehler, Mike, Ph.D., Assistant Professor
Frey, Bruce, Ph.D., Research Associate
Frolander, Herbert F., Ph.D., Professor
Gemperle, Mike, M.S., Instructor
Gonor, Jefferson, Ph.D., Associate Professor
Gordon, Louis I., Ph.D., Associate Professor
Hancock, Daneil, M.S., Assistant Professor
Heath, G. Ross, Ph.D., Dean
Hogan, Lewis, Ph.D., Research Associate
Holton, Robert, Ph.D., Assistant Professor
Hutson, William, Ph.D., Assistant Professor
Huyer, Jane, Ph.D., Assistant Professor
Johnson, Richard, Ph.D., Assistant Professor
Johnson, Stephen, Ph.D., Associate Professor
Keller, George H., Ph.D., Associate Dean
Komar, Paul D., Ph.D., Professor
Kulm, LaVerne D., Ph.D., Professor
Levi, Shaul, Ph.D., Assistant Professor
Mate, Bruce, Ph.D., Assistant Professor
Mesecar, Roderick S., Ph.D., Associate Professor
Miller, Charles B., Ph.D., Associate Professor
Morita, Richard Y., Ph.D., Professor
Neal, Victor T., Ph.D., Associate Professor
Nelson, David, Ph.D., Assistant Professor
Neshyba, Stephen J., Ph.D., Professor
Niiler, Pearn, Ph.D., Professor
Pak, Hasong, Ph.D., Associate Professor
Panshin, Daniel, Ph.D., Associate Professor
Paulson, Clayton A., Ph.D., Associate Professor
Pearcy, William G., Ph.D., Professor
Pillsbury, Dale, Ph.D., Associate Professor
Pytkowicz, Ricardo M., Ph.D., Professor
Quinn, William, Ph.D., Associate Professor
Redmond, Richard C., Port Capt./Mar. Supt.
Richman, James G., Ph.D., Assistant Professor
Scheidegger, Kenneth, Ph.D., Associate Professor
Schrader, Hans, Ph.D., Associate Professor
Small, Lawrence F., Ph.D., Professor
Smith, Robert L., Ph.D., Professor
Suess, Erwin, Ph.D., Associate Professor
Swartz, Richard C., Ph.D., Assistant Professor
Zaneveld, Ronald, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Student Advisor
School of Oceanography
Oregon State University
Corvallis, Oregon 97331

MARINE SCIENCE CENTER - Newport, Oregon 97365

Facilities and Equipment

The main building houses research facilities for investigations in marine fisheries, commercial fisheries engineering, aquaculture, water quality, marine biology, microbiology, zoology, and oceanography. The laboratories are equipped with cold rooms, a freezer room, dark rooms, a data processing room with punch card equipment and a link to the Corvallis computer, and instrument rooms housing such major items of equipment as autoclaves, centrifuges, balances, spectrophotometers, flame photometers, gas chromatographs, an atomic absorption spectrophotometer, and radiation measuring equipment. Wet laboratories are provided with running fresh and sea water. Meeting rooms and lecture rooms are located in close proximity to the laboratories.

Two ocean-going research vessels, the 54-meter Wecoma and the 24-meter Cayuse are docked at the Center. The Paiute, a 10-meter vessel, is used within the bay and nearshore waters, and several small boats are available for work within the bay.

The OSU Marine Science Center is located on Yaquina Bay, a mile from the open waters of the Pacific Ocean. Across the bay, to the north, is the town of Newport.

The Marine Science Center does not offer degrees; all degrees are awarded through departments on the main campus. Departments involved with research and teaching at the Marine Science Center are: Agricultural Engineering, Agricultural and Resource Economics, Botany and Plant Pathology, Food Science and Technology, Fisheries and Wildlife, Microbiology, Oceanography, Pharmacology, and Zoology.

All courses offered are senior or graduate level (G/g).

AE	407/507	Aquacultural Engineering Seminar	1
AREc	408	Marine Economics	3
Bot	480	Marine Algae	5
Bot	485X	Taxonomy and Ecology of Marine and Estuarine Diatoms	5
FST	451	Current Topics in Food Science	3
FW	507M	Seminar: Fisheries Population Biology	1
FW	571	Functional Ichthyology	4
Mb	450	Marine Microbiology (plus two hour laboratory)	3
Mb	492	Diseases of Fishes (plus two hour laboratory)	3
Oc	442	Marine Zooplankton (plus two hour laboratory)	3
Z	451	Invertebrate Zoology	5
Z	452	Invertebrate Zoology	5

The OSU Marine Science Center offers coursework spring and summer terms.

The faculty of the Marine Science Center consists of the following:

Baross, John A., Ph.D., Research Associate in Marine Microbiology
Beasley, Thomas M., Ph.D., Associate Professor, Measurement of Environmental Levels of Radioactivity
Breese, Wilbur P., M.S., Associate Professor, Oyster Culture
Crawford, David L., Ph.D., Professor of Food Science and Technology
Fryer, John, Ph.D., Professor of Microbiology
Giles, Donald E., M.A., Assistant Professor, Extension Marine Education Specialist
Gonor, Jefferson J., Ph.D., Associate Professor of Oceanography - Invertebrate Zoology
Guin, Marilyn, M.L.S., M.S., MSC Librarian
Hilderbrand, Kenneth S., M.S., Associate Professor, Sea Grant Director
Kolbe, Edward R., Ph D., Assistant Professor of Agricultural Engineering
Lannan, James E., Ph.D., Assistant Professor of Fisheries
Mate, Bruce R., Ph.D., Assistant Professor of Oceanography, Marine Mammals

McIntire, C. David, Ph.D., Professor of Botany
Olson, Robert E., Ph.D., Assistant Professor of Fisheries, Fish Diseases
Osis, Vicki J., M.A., Extension Marine Education Specialist
Peterson, William, M.S., Instructor, Coastal Zooplankton
Phinney, Harry K., Ph.D., Professor of Botany, Marine Algae
Smith, Fred J., Ph.D., Professor of Agricultural and Resource Economics
Swartz, Richard C., Ph.D., Assistant Professor of Oceanography, Benthic Ecology
Tyler, Albert V., Ph.D., Associate Professor of Fisheries
Weber, Lavern J., Ph.D., Professor of Pharmacology and Fisheries, Director of OSU Marine Science Center, Comparative Toxicology and Pharmacology

To obtain further information, address inquiries to:

Director
OSU Marine Science Center
Newport, Oregon 97365

DEPARTMENT OF FISHERIES AND WILDLIFE

The Department of Fisheries and Wildlife is headquartered in Nash Hall on the Corvallis campus of Oregon State University. Construction of Nash Hall was completed in 1970 and contains 66,304 net square feet of space for use by the Department.

Facilities include lecture rooms, teaching and research laboratories, constant temperature rooms, self-learning center, walk-in freezer, shop, ichthyological museum, radiation laboratory, offices for staff and graduate students and numerous supporting facilities.

Research into all aspects of fisheries are carried out at the following facilities which are not located on the Corvallis campus: Marine Science Center, Netarts Bay Laboratory, Soap Creek Experimental Ponds, Berry Creek Experimental Stream, Oak Creek Laboratory, and a fish culture laboratory.

The following degrees are offered by the Department:

1. B.S. in Fisheries Science. All undergraduate students must complete the following:

Orientation to Fisheries and Wildlife Seminar
Principles of Wildlife Conservation
Economic Ichthyology
Introduction to Population Dynamics or
Dynamics of Marine Biological Resources
Fishery Biology
Limnology
Commercial Fisheries
Fisheries Seminar (two terms)
One course from Wildlife Option List

Non-departmental requirements include:

Communications	12 credits
Humanities	12 credits
Social Sciences	12 credits
Economics	3 credits
Biological and Physical Sciences	83 credits

A total of 192 term hours of undergraduate credit is required for the B.S. degree.

2. M.S. in Fisheries Science. All students must complete a program of study totaling not less than 45 term hours including thesis (six to nine hours) and courses approved for graduate credit. Approximately two-thirds of the work (30 term hours) must be in the major and one-third (15 term hours) in the minor. A residence of one academic year of fair equivalent is required. There is no foreign language requirement for the M.S. degree.

3. M.Agr. degree in Aquaculture. The Master of Agriculture degree emphasizing Aquaculture is a non-thesis degree based on coursework and a paper. The student will be required to participate in some practical aspect of aquaculture. It requires a minimum of 45 credits, no more than 21 of which can be in the major department. The remaining 24 are to be divided between two additional agriculture-related departments, with a minimum of nine in any department. Part of the major requirements is a research paper of three to five credits, registered as Reading and Conference, FW 505. This degree can be completed in twelve to eighteen months.

The Ph.D. degree is granted primarily for attainments and proved ability. There is no rigid credit requirement. The equivalent of at least three years full-time graduate work beyond the bachelor's degree is a university requirement, but programs in this department usually take longer. At least one academic year must be spent in continuous residence at OSU with a minimum of 36 hours of graduate work. The foreign language requirement is determined by the student's doctoral committee subject to approval by the major department and the Dean of the Graduate School. A comprehensive preliminary examination is required for admission to candidacy for the Ph.D. degree. Every candidate must submit a thesis embodying the results of research and giving evidence of originality and ability in independent investigation (usually 30-45 term hours). All candidates must pass a final examination, part of which must be oral.

Degrees granted in 1978: 69 B.S., 10 M.S., 2 M.Agr., 3 Ph.D.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

FW 313	Economic Ichthyology	5
FW 314	Economic Ichthyology	4
FW 315	Aquaculture	3
FW 320	Introduction to Population Dynamics	4

GRADUATE COURSES

FW 431	Dynamics of Marine Biological Research	4
FW 454	Fishery Biology	5
FW 455	Fish Culture	3
FW 456	Fishery Limnology	3
FW 457	Fishery Limnology Laboratory	2
FW 465	Commercial Fisheries	5
FW 466	Invertebrate Fisheries	4
FW 470	Water Pollution Biology	3
FW 471	Functional Fishery Biology	4
MB 492	Parasites and Diseases of Fish	3
MB 493	Parasites and Diseases of Fish Lab	2
FW 555	Fish Genetics	3

FW 567	Research Perspectives	4
FW 568	Research Perspectives	4
FW 569	Population Dynamics	4
FW 570	Pollution Problems in Fisheries	3
FW 571	Functional Ichthyology	4
FW 572	Systematics of Fishes	3
FW 573	Special Topics in Ichthyology	3
FW 580	Stream Ecology	3

The instructional staff for the courses listed above consists of the following:

Bond, Carl E., Ph.D., Professor
Breese, W.P., M.S., Assistant Professor
Coblentz, Bruce E., Ph.D., Assistant Professor
Cummins, Kenneth W., Ph.D., Professor
Fryer, John L., Ph.D., Professor
Hall, James D., Ph.D., Associate Professor
Horton, Howard F., Ph.D., Professor
Lannan, James E., Ph.D., Assistant Professor
Li, Hiram W., Ph.D., Associate Professor
Liss, William J., Ph.D., Assistant Professor
Olson, Robert, Ph.D., Assistant Professor
Schoning, Robert W., B.S., Professor
Schreck, Carl B., Ph.D., Assistant Professor
Seim, Wayne K., M.S., Senior Instructor
Tubb, Richard A., Ph.D., Professor
Tyler, Albert V., Ph.D., Associate Professor
Warren, Charles E., Ph.D., Professor
Weber, Lavern, Ph.D., Professor

To obtain further information, address inquiries to:

Dr. Richard A. Tubb, Head
Department of Fisheries and Wildlife
Oregon State University
Corvallis, Oregon 97331

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

The Department of Food Science and Technology is housed in two modern buildings on the Corvallis campus. These buildings contain 78,000 square feet of office, teaching and research laboratory and pilot plant space. The facilities are designed and well equipped to carry out teaching and research activities peculiar to most areas in the food field.

The Food Science Seafoods Laboratory is located at Astoria, Oregon, on the Columbia-Youngs River estuary. This research center has been operated as an integral part of the department since 1940. The facility provides 7,000 square feet of laboratory and office space and serves as a center for marine food science research.

Adjacent to the central university campus, the department operates the Food Toxicology and Nutrition Laboratory. This laboratory is especially designed for studies of toxicity, nutrition and carcinogenesis in fish. Its 5,500 square feet of laboratory and office space includes a complete histopathological laboratory and 140 separate fish rearing tanks abundantly supplied with a constant temperature water supply.

Food science and technology is the application of the sciences and engineering to the manufacture, preservation, storage, transportation and consumer use of food products. The food science program is concerned with the science and research involving the chemical, physical, biological, microbiological, toxicological and nutritive properties of foods.

The University offers the following degrees in food science and technology:

1. B.S. in Food Science and Technology. The minimum course requirements consist of the following: Food Science and Technology, Communications, Humanities and Social Sciences, Biological and Physical Sciences, Physical Education, and electives, for a total of 192 term hours.

2. M.S. in Food Science. Students must complete a program of study totaling not less than 45 term hours including thesis and courses approved for graduate credit. Approximately two-thirds of the work (30 term hours) must be in the major or be composed of courses approved by the major department in the basic sciences and one-third (15 term hours) in the minor. Three credit hours of seminar are recommended with the thesis representing nine to 12 hours of major credit, which must be the result of the student's independent research and preparation. No qualifying examination is required for the M.S. degree. A final oral examination of not less than two hours is required for presentation of the student's thesis and examination of this thesis and field of study.

3. Ph.D. in Food Science. The degree of Ph.D. is granted primarily for attainments and proved ability and prepares the student for research in a specialized field of study. A M.S. degree or equivalent (as evaluated by the graduate faculty of the department) is required for a student who intends to work toward a Ph.D. degree. The student and his major professor formulate the Ph.D. study program. The Ph.D. program usually consists of 75 to 85 term hours beyond that required for a M.S. degree and is composed of approximately two-third's formal coursework and one-third thesis research. For the Ph.D. degree, the student's doctoral committee determines on the basis of the student's needs and the foreign language scientific literature in his field of specialization if two, one or no foreign language will be required or permitted. If no foreign language requirement is recommended by the student's doctoral committee, the foreign language requirement will be satisfied by, one, the taking of a course or courses (undergraduate or graduate) which are in subjects not usually included for credit in the major or minor and which will have as their purpose the broadening of the student or to provide a "tool" of particular value, and/or two, a special project, other than laboratory research, which would distinctly benefit the student. Written and oral preliminary examinations are required. A thesis which is the result of the student's independent research and preparation is required to demonstrate an independent research capability. The candidate is expected to defend his thesis and knowledge of his field in a final oral examination.

The following courses are offered in conjunction with the above programs:

FST 111	Food Quality Evaluation	3
FST 112	Food and Man	3
FST 113	Food Science Colloquium	1
FST 221, 222, 223	Food Processing	12
FST 411, 412, 413	Food Chemistry	12

FST 421	Food Law	3
FST 423	Food Analysis	5
FST 424	Quality Control Systems	3
AET 441, 442, 443	Food Engineering	10
FST 407	Seminar	1
FST 451	Current Topics in Food Science	-3
FST 531	Carbohydrates in Foods	3
FST 532	Food Flavors and Evaluation	3
FST 533	Lipids in Foods	3
FST 551	Food Toxicology	3
FST 561	Pigments and Color Evaluation	3
FST 562	Proteins in Foods	3
FST 563	Enzymes in Foods	3
FST 507	Seminar	1-6
Mb 440, 441	Food Microbiology	5
Mb 442, 443	Dairy Microbiology	4
Mb 446, 447	Industrial Microbiology	4

The instructional staff for the courses listed above consists of the following:

Anglemier, Allen F., Ph.D., Professor
Babbitt, Jerry K., Ph.D., Associate Professor
Beavers, Darrell V., B.S., Associate Professor
Bodyfelt, Floyd W., M.S., Professor
Crawford, David L., Ph.D., Professor
Heatherbell, David A., Ph.D., Associate Professor
Hendricks, Jerry D., Ph.D., Assistant Professor
Kifer, Paul E., Ph.D., Professor and Head
Kirk, Dale E., M.S., Professor of Agricultural Engineering
Krumperman, Paul H., Ph.D., Associate Professor
Law, Duncan K., B.S., Professor
Lee, Jong S., Ph.D., Professor
Libbey, Leonard M., Ph.D., Associate Professor
McGill, Lois A., B.S., Professor
Montgomery, Morris W., Ph.D., Associate Professor
Nixon, Joseph E., Ph.D., Associate Professor
Pawlowski, Norman E., Ph.D., Associate Professor
Sandine, William E., Ph.D., Professor
Scanlan, Richard A., Ph.D., Professor
Selivonchick, Daniel P., Ph.D., Assistant Professor
Sinnhuber, Russell O., M.S., Professor
Varseveld, George W., M.S., Assistant Professor
Wrolstad, Ronald E., Ph.D., Associate Professor
Wyatt, C. Jane, Ph.D., Associate Professor
Yu, Teh C., M.S., Associate Professor

To obtain further information, address inquiries to:

Dr. Paul E. Kifer, Head
Department of Food Science and Technology
Oregon State University
Corvallis, Oregon 97331
(503) 754-3131

SCHOOL OF ENGINEERING

The School of Engineering has a variety of specialized laboratories and complementary facilities for use in the ocean engineering research and training programs. The following major facilities are used for student training and research needs: environmental fluid dynamics laboratory wave basin, hydraulic laboratory, fluid measurements laboratory, hydrologic facilities, marine science center engineering laboratory, sanitary engineering laboratories, photogrammetry laboratory, soil mechanics laboratory, structural engineering laboratory, engineering materials laboratory, mechanical engineering laboratory, instrumentation laboratory, electrochemical engineering laboratory, underwater acoustics laboratory and simulation laboratory.

The computer center, oceanography laboratories, radiation center and Marine Science Center are also extensively used in the ocean engineering program, together with vessels of the Oceanography School and facilities of the Pacific Northwest Water Laboratory of the Environmental Protection Agency.

The principal research areas for studies on estuarine hydraulics, water resources and ocean engineering are the rivers, lakes, reservoirs, estuaries, and coast of Oregon. Where convenient, temporary field research offices have been established; in other cases, departmental vehicles and ocean engineering boats (six craft up to 25 feet long) have provided temporary instrument shelters for environmental research.

Graduate study in ocean engineering is offered at Oregon State University through the School of Engineering. This program of study leads to the degrees of Master of Ocean Engineering or Master of Science and Doctor of Philosophy in engineering with an emphasis on ocean engineering. The graduate student in ocean engineering, depending on his specific interests, is admitted to an established department in the School of Engineering: civil, chemical, electrical, industrial, mechanical and metallurigcal or nuclear engineering. A program of study is then designed to fit the individual's professional objectives and to achieve a high degree of engineering competence related to the ocean environment. The following requirements are to be met in obtaining a degree through the ocean engineering program:

Major: An area of ocean engineering specialization within one or more of the established engineering disciplines. Minor: Supporting coursework in ocean engineering and/or oceanography plus other appropriate courses to prepare the student for professional work in the ocean-oriented industries and agencies. Thesis research: Each student must conduct research and prepare a thesis on a pertinent subject concerning engineering in the marine environment. Program of study: The program must meet approval of the ocean engineering committee of the School of Engineering.

The Ph.D. program requires at least three years of study beyond the baccalaureate degree and includes about 135 quarter credit hours of course and thesis work. The Master of Ocean Engineering and the Master of Science in Engineering degrees require 45 quarter credit hours, including research.

The following courses are offered in conjunction with the above programs:

GRADUATE COURSES

CE 521	Hydraulic Systems	3
CE 524	Sediment Transport	3
CE 525	River Control and Utilization	3
CE 526	Hydraulics of Open Channels	3
CE 531	Analysis of Engineering Structures	3
CE 532	Matrix Methods of Structural Analysis	3
CE 533	Structural Stability	3
CE 540, 541	Sanitary Engineering Processes	3, 3
CE 544	Water Quality Analysis	3
CE 548	Water Quality Dynamics	3

CE 566	Ocean Position Surveying	3
CE 570	Coastal Hydraulics	3
CE 572	Estuarine Transport	3
CE 573	Ocean Engineering Design	3
CE 574	Ocean Engineering Facilities Planning	3
CE 578	Marine Geotechnique	3
CE 579	Special Topics in Ocean Engineering	1
ChE 514	Fluid Flow	3
EE 414, 415, 416	Systems Instrumentation	3, 3, 3
EE 421, 422	Transmission Systems	3, 3
EE 451, 452, 453	System Engineering	3, 3, 3
EE 461, 462, 463	Communication Engineering	3, 3, 3
EE 471, 472, 473	Logical Design and Digital System Engineering	3, 3, 3
EE 491, 492, 493	Control Engineering	3, 3, 3
EE 514, 515, 516	Advanced Solid State Electronics	3, 3, 3
EE 525, 526, 527	Computer Systems	3, 3, 3
EE 551, 552, 553	Microwave Circuits	3, 3, 3
EE 554, 555	Control Systems	3, 3
EE 556, 557, 558	Multivariable Systems	3, 3, 3
EE 560	Signals and Noise	3
EE 561, 562	Communication Systems	3, 3
EE 590, 591, 592	Systems Simulation	3, 3, 3
EE 593	Simulation Fundamentals	3
EE 507	Ultra Sonics Seminar	-
IE 441	Environmental Design	3
IE 471, 472	Management Models	3, 3
IE 491	Quality and Reliability Control	4
IE 505	Marine Work Design	-
IE 521, 522, 523	Selected Topics in Industrial Engineering	3, 3, 3
IE 571, 572, 573	Systems Theory and Cybernetics	3, 3, 3
ME 416	Applied Mechanics	3
ME 417, 418	Statics of Deformable Structures	3, 3
ME 431, 432	Power Plant Engineering	3, 3
ME 477	Measurement and Control of Sound	3
ME 480, 481, 482	Dynamics of Physical Systems	3, 3, 3
ME 514, 515	Mechanical Design	3, 3
ME 516, 517	Systems Engineering	3, 3
ME 525, 526	Thermodynamics	3, 3
ME 531	Selected Topics in Thermodynamics	3
ME 527, 528, 529	Heat Transfer	3, 3, 3
ME 550	Continuum Mechanics	3
ME 551, 552	Elasticity	3, 3
ME 557	Incompressible Fluid Mechanics	3
ME 559	Selected Topics in Fluid Mechanics	3
ME 560	Experimental Mechanics	3
ME 566, 567, 568	Advanced Dynamics	3, 3, 3
ME 573	Numerical Methods for Engineering Analysis	3

Professional staff available for the graduate training program in ocean engineering include:

CIVIL ENGINEERING

Bell, J.R., Ph.D., Professor
Bella, D.A., Ph.D., Associate Professor
Hicks, R.G., Ph.D., Associate Professor
Hudspeth, R., Ph.D., Assistant Professor
Klingeman, P.C., Ph.D., Associate Professor
Layton, R., Ph.D., Associate Professor
Nath, J.H., Ph.D., Professor
Schaumburg, F.D., Ph.D., Associate Professor and Head
Schroeder, W.L., Ph.D., Associate Professor
Seaders, J., M.S., Associate Professor
Slotta, L.S., Ph.D., Associate Professor
Sollitt, C.K., Ph.D., Assistant Professor
Williamson, K., Ph.D., Associate Professor

ELECTRICAL AND ELECTRONICS ENGINEERING

Jensen, L.C., M.S., Associate Professor
Owen, S.J., Ph.D., Professor and Head
Saugen, J.S., Ph.D., Associate Professor
Weber, L.J., M.S., Professor

INDUSTRIAL ENGINEERING

Croff, H.L., M.S., Assistant Professor
Inoue, M.S., Ph.D., Professor
McDowell, E., Ph.D., Assistant Professor
Riggs, J.L., Ph.D., Professor and Head

MECHANICAL AND METALLURGICAL ENGINEERING

Bucy, D., M.S., Associate Professor
Bushnell, D., Ph.D., Assistant Professor
Davis, L.R., Ph.D., Associate Professor
Johnson, L.E., Ph.D., Associate Professor
McMullen, W.D., Ph.D., Associate Professor
Mingle, J.G., M.S., Professor
Smith, C.E., Ph.D., Associate Professor
Thresher, R.W., Ph.D., Assistant Professor
Welty, J.R., Ph.D., Professor and Head
Wilson, R.E., Ph.D., Professor
Zaworski, R.J., Ph.D., Professor

To obtain further information, address inquiries to:

W.L. Schroeder, Assistant Dean
School of Engineering
Oregon State University
Corvallis, Oregon 97331

PENINSULA COLLEGE
Port Angeles, Washington 98362

The College is located only one mile from the Strait of Juan De Fuca, has four large lakes within

15 miles, and state fish hatcheries and rearing ponds nearby.

The fisheries complex contains one classroom, one lab-classroom, office for two instructors, an equipment room, museum, workshop, and small fish hatchery. Numerous small boats are available. Field projects and work with state and federal agneices is emphasized.

The degree of Associate of Applied Arts (Fisheries Certificate) and the AAS degree are offered.

FISHERIES TECHNOLOGY

This program prepares a student to perform assignments as a scientific or biological aid under the direction of a fisheries biologist. Completion of the following curriculum (or equivalent) qualifies the student for the fisheries certificate and the AAS degree.

The following courses are offered in conjunction with the above program:

T. FISH. 100	Tehnical Report Writing	2
T. FISH. 105	Taxonomy of Fishes	4
T. FISH. 116	Hatchery Methods	2
T. FISH. 117	Hatchery Methods	2
T. FISH. 118	Hatchery Methods	2
T. FISH. 120	Life History of Fishes	3
T. FISH. 125	Population Studies	3
T. FISH. 200	Fish Diseases	3
T. FISH. 205	Aquatic Plants	4
T. FISH. 210	Aquatic Environments	3
T. FISH. 216	Technical Statistics	3
T. FISH. 217	Technical Statistics	3
T. FISH. 220	Wildlife Management	4
T. FISH. 225	Commercial Fisheries	4
T. FISH. 240	Aquatic Insects	4
T. FISH. 245	Marine Invertebrates	4
T. FISH. 250	Microtechnique	4
T. FISH. 295	Special Projects (Seminar or directed study)	1-6

The instructional staff for the courses listed above consists of the following:

FISHERIES DEPARTMENT

Grinols, Richard B., M.S., Instructor
Mausolf, Robert G., B.S., Instructor
Well, Donald R., B.S., Instructor

To obtain further information, address inquiries to:

Leonard W. Beil, Director
Vocational Education
Peninsula College
1502 East Lauridsen Boulevard
Port Angeles, Washington 98362
(206) 452-9277

THE PENNSYLVANIA STATE UNIVERSITY
University Park, Pennsylvania 16802

The following specialized facilities are available at the University: laboratories in marine geology, special meteorological equipment for courses in marine meteorology, and a laboratory for underwater acoustics. In addition, the University is a member of the Marine Science Consortium, and through the Consortium has access to facilities at Wallops Station, Virginia.

No formal degree programs are offered in marine science; however, a marine science concentration area is available to students in allied major fields. A marine science certificate may be earned by successfully completing the requirements in the concentration area. Baccalaureate and advanced degrees are offered in the allied fields of geological sciences (geology, geophysics, mineralogy, and geochemistry), meteorology, geography, biology and physics. Students who are candidates for degrees in these disciplines can schedule certain courses in the marine sciences.

Spring Field Term. Students in the above fields may participate in a spring term of ten weeks of field courses taught by Penn State faculty at the Wallops Station site of the Marine Science Consortium. This program includes coursework in marine instrumentation, coastal geology, and coastal biology.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF AEROSPACE ENGINEERING

Aersp 412	Turbulent Flow	3
Aersp 506	Cavitation	3
Aersp 514	Stability of Laminar Flows	3
Aersp 515	Foundations of Turbulence	3
Aersp 516	Homogeneous Turbulence	3
Aersp 517	Inhomogeneous Turbulence	3
Aersp 597C	Geophysical Fluid Dynamics	3

DEPARTMENT OF BIOLOGY

Bio 280	Life in the Sea	2
Bio 417	Invertebrate Zoology	4
Bio 435	Ecology of Lakes and Streams	3
Bio 452	Ichthyology	3
Bio 454	Herpetology	2
Bio 517	Fish Behavior	3
Bio 540	Phycology	4
Bio 544	Physiological Ecology	3
Bio 547	Invertebrate Biology	3

COLLEGE OF ENGINEERING

Engr 200	Field Methods in Physical Oceanography	4

ENGINEERING ACOUSTICS PROGRAM

E Acs 511	Underwater Sound Propagation	3
E Acs 515	Acoustics in Fluid Media	3

DEPARTMENT OF GEOSCIENCES

GM	522	Geochemistry of Aqueous Systems	3
G Sc	40	Oceans and Man	3
G Sc	440	Marine Geology	3
G Sc	442	Evolution of Coastlines	3
G Sc	445	Coastal Geology	4
G Sc	540	Chemical Oceanography	3

DEPARTMENT OF METEOROLOGY

Met	320	The Oceans	2
Met	407	Elements of Physical Oceanography	3
Met	445	Hydrology for Meteorologists	3
Met	507	Dynamic Oceanography	2

DEPARTMENT OF MICROBIOLOGY

Micro	529	Aquatic Microbiology	3

DEPARTMENT OF PHYSICS

Phys	443	Intermediate Acoustics	3
Phys	533	Theoretical Acoustics	3

Courses carrying a 400 number may be scheduled by undergraduate and graduate students; those carrying a 500 number can be scheduled only by graduate students.

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF AEROSPACE ENGINEERING

Eisenhuth, J. Joseph, Ph.D., Associate Professor of Aerospace Engineering
Holl, J. William, Ph.D., Professor of Aerospace Engineering
McCormick, Barnes W., Ph.D., Professor of Aerospace Engineering
Morris, Philip J., Ph.D., Assistant Professor of Aerospace Engineering

APPLIED RESEARCH LABORATORY

Farwell, Robert W., Ph.D., Associate Professor of Engineering Research
Snyder, Roger F., B.S., Research Associate
Welser, Edward V., Jr., M.S., Research Associate
Whitmarsh, David C., Jr., M.S., Associate Professor of Engineering Research

DEPARTMENT OF BIOLOGY

Burris, John E., Ph.D., Assistant Professor of Biology
Bursey, Charles, Ph.D., Associate Professor of Biology
Butler, Robert L., Ph.D., Professor of Biology
Cooper, Edwin L., Ph.D., Professor of Zoology
Dunson, William A., Ph.D., Professor of Biology
Hillson, Charles J., Ph.D., Professor of Botany
Pearson, David L., Ph.D., Assistant Professor of Biology
Reimer, Amada, Ph.D., Assistant Professor of Biology

DEPARTMENT OF CIVIL ENGINEERING

Unz, Richard F., Ph.D., Associate Professor of Sanitary Microbiology

DEPARTMENT OF GEOSCIENCES

Guber, Albert L., Ph.D., Associate Professor of Geology
Lasaga, Antonio C., Ph.D., Assistant Professor of Geochemistry
Schmalz, Robert F., Ph.D., Professor of Geology
Slingerland, Rudy L., Ph.D., Assistant Professor of Geology
Williams, Eugene G., Ph.D., Professor of Geology

DEPARTMENT OF METEOROLOGY

Blackadar, Alfred K., Ph.D., Professor of Meteorology
Panofsky, Hans A., Ph.D., Evan Pugh Professor of Atmospheric Research

To obtain further information, address inquiries to:

Marine Science Committee
The Pennsylvania State University
117 Old Main
University Park, Pennsylvania 16802

POMONA COLLEGE
Claremont, California 91711

Facilities for undergraduate study in marine science include the undergraduate teaching and research laboratories in biology, geology and physics. Research equipment includes apparatus for analyzing chemical and physical properties of the marine environment, such as oxygen and other dissolved gases, salinity, chlorinity, other specific ions, trace nutrients, and pH; centrifuges, including a continuous-flow centrifuge; vapor-pressure osmometer; spectrophotometers; flame photometers; equipment for x-ray diffraction, x-ray fluorescence spectrography, electron microprobe analysis, and atomic absorption analysis; gas and liquid chromatography; electron (SEM, TEM), phase-contrast, fluorescence, compound, and dissecting microscopes; photography equipment, including an underwater Nikonos camera and complete darkroom facilities; walk-in constant temperature and controlled-environment rooms; a recirculating sea-water aquarium system with nine 35-gallon aquaria, two 250-gallon capacity storage tanks, and filtration and cooling units. A well-equipped shop is available for construction of specialized equipment, including electronic. An IBM System/360 Model 40 computer with 128 K characters of storage, three disk drives, four tape drives, one printer, one card reader/punch, and a Calcomp plotter is available for student and faculty use in teaching and research. Field equipment available includes a variety of plankton nets, biological grabs and dredges, water samplers, etc. The nearby Bernard Field Station of the Claremont Colleges includes a small artificial lake useful for developing techniques for sampling and studying aquatic habitats. There is ready access to the R/V Vantuna, an 85-foot tuna clipper equipped with a wide variety of equipment for research and teaching in biological, physical, chemical, and geological oceanography.

Pomona College is a four-year liberal arts college, offering the Bachelor of Arts degree in a number of fields. In the sciences, basic background and broad knowledge are emphasized, rather than specialization in particular narrow fields. About four to six students each year graduate with a B.A. degree in fields related to marine science and go on to graduate study. In addition to the more standard concentrations in biology, geology and physics, special concentrations such as environmental sciences, biology-mathematics and marine biology have been arranged for individual students. Thirty-two courses (128 semester hours) are required for the B.A. degree, with distribution depending on the concentration chosen. Usually about one-fourth to one-third of the program must be within the major field and closely related fields.

The following courses are offered in conjunction with the above program:

Biol 61	General Biology: Evolution and Ecology
Biol 102	Population and Community Ecology
Biol 104	Plant Ecology
Biol 106	Aquatic Biology
Biol 122	Algae and Mosses
Biol 130	Invertebrate Biology
Biol 140/141	Comparative Animal Physiology
Biol 189	Seminars in Selected Topics in Biology
Biol 199	Introduction to Research in Biology
Geol 54	Geological Oceanography
Geol 107	Geophysics and Global Tectonics
Geol 159	Stratigraphy and Sedimentation
Geol 199	Selected Topics in Geology
Phys 4	Introductory Oceanography
Phys 199	Independent Study and Research

Courses offered in the Joint Sciences Department of Scripps, Claremont Men's, and Pitzer Colleges, in which Pomona students may cross-register, are:

Biol 133	Freshwater Ecology
Biol 140	Invertebrate Biology
Biol 146	Ecology
Biol 169	Topics in Marine Biology
ES 61	Environmental Problems
ES 62	Man and His Environment
ES 171	The Politics of Water

The instructional faculty for the courses listed above consists of the following:

BIOLOGY

Carlquist, Sherwin, Ph.D., Norton Professor
Oglesby, Larry C., Ph.D., Professor
Phillips, Edwin A., Ph.D., Bent Professor
Yeaton, Richard I., Ph.D., Assistant Professor

GEOLOGY

McIntyre, Donald B., Ph.D., Cairns Professor
Zenger, Donald H., Ph.D., Professor

PHYSICS

Miller, Jack C., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. Larry C. Oglesby
Biology Department
Pomona College
Claremont, California 91711
(714) 621-8000, ext. 2950/2993/2948

PRINCETON UNIVERSITY
Princeton, New Jersey 08544

The principal facilities are the geological, paleontological and geophysical laboratories of the Department of Geological and Geophysical Sciences, and the Geophysical Fluid Dynamics Laboratory of NOAA on the Forrestal Campus. Princeton University is a member of the New Jersey Marine Sciences Consortium with teaching and research laboratories and small boats at the Sandy Hook Marine Laboratory and the Seaville Field Station.

The following degrees are offered:

1. A.B. in Geology. Normally 12 one-term courses in a department or related fields, and a senior thesis.

2. B.S.E. (Geological Engineering). Normally 12 one-term courses in engineering, geology and related sciences, and a senior thesis.

3. Ph.D. in Geology. Completion of one year of residence, passing general examination, and completion and defending a dissertation.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

GEOLOGY

Geo. 210	Introduction to Oceanography
Geo. 276	Introduction to Water Resources
Geo. 305	Evolution of Invertebrates
Geo. 308	Origin of Sedimentary Rocks
Geo. 314	Environmental Studies: The Physical Setting
Geo. 315	Land Forms and Terrain Interpretation
Geo. 317	Introduction to Geochemistry
Geo. 320	Applied Geophysics

Geo. 405	Introduction to Micropaleontology
Geo. 409	Special Topics in Paleontology
Geo. 412	Aqueous Environmental Geochemistry
Geo. 415	History of the Ocean Basins
Geo. 425	Introduction to Physical Oceanography
Geo. 471	Introduction to Water Pollution Technology

BIOLOGY

Bio. 305	Population Biology
Bio. 403	Field Biology

ENGINEERING AND APPLIED SCIENCE

CE	208	Mechanics of Fluids
CE	213	Energy and Environment
CE	275	Engineering and Environmental Geology
CE	304	Surface and Subsurface Hydrology
CE	471	Introduction to Water Pollution Technology

GRADUATE COURSES

GEOLOGICAL AND GEOPHYSICAL SCIENCES

Geo. 521	Sedimentary Petrology
Geo. 522	Chemical Sediments
Geo. 523	Sedimentary Environments
Geo. 527	Paleoecology
Geo. 552	Introduction to General Seismology

PROGRAM IN GEOPHYSICAL FLUID DYNAMICS

GFD. 571	Introduction to Geophysical Fluid Dynamics
GFD. 572	Atmospheric and Oceanic Wave Dynamics
GFD. 573	Dynamics and Modeling of Ocean Currents
GFD. 574	Dynamics of Atmospheric Circulation and Climate
GFD. 575	Dynamical Modeling of the Atmosphere
GFD. 576	Special Topics in Geophysical Fluid Dynamics

The instructional staff for the courses listed includes the following:

GEOLOGICAL AND GEOPHYSICAL SCIENCES

Bonini, W.E., Ph.D., Professor
Crerar, D.A., Ph.D., Assistant Professor
Dahlen, F.A., Ph.D., Professor
Deffeyes, K.S., Ph.D., Professor
Dowty, E., Ph.D., Assistant Professor
Fischer, A.G., Ph.D., Professor
Hargraves, R.B., Ph.D., Professor
Hollister, L.S., Ph.D., Professor
Judson, S., Ph.D., Professor
Morgan, W.J., Ph.D., Professor
Phinney, R.A., Ph.D., Professor
Sachs, H.M., Ph.D., Assistant Professor
Spera, F., Ph.D., Assistant Professor
Suppe, J., Ph.D., Professor
Thompson, I., Ph.D., Assistant Professor
Van Houten, F.B., Ph.D., Professor

BIOLOGY

Horn, H.S., Ph.D., Associate Professor
May, R.M., Ph.D., Professor
Terborgh, J.W., Ph.D., Associate Professor

ENGINEERING AND APPLIED SCIENCE

Farrara, R., Ph.D., Assistant Professor
Gray, W.G., Ph.D., Assistant Professor
Mellor, G.L., Ph.D., Professor
Pinder, G.F., Ph.D., Professor
Prevost, J.H., Ph.D., Assistant Professor

PROGRAM IN GEOPHYSICAL FLUID DYNAMICS

Bryan, K., Ph.D., Lecturer with rank of Professor
Kurihara, Y., Ph.D., Lecturer with rank of Professor
Manabe, S., Ph.D., Lecturer with rank of Professor
Miyakoda, K., Ph.D., Lecturer with rank of Professor
Oort, A.H., Ph.D., Lecturer with rank of Professor
Orlanski, I., Ph.D., Lecturer with rank of Professor
Smagorinsky, J., Ph.D., Lecturer with rank of Professor

Mahlman, J.D., Visiting Lecturer with rank of Associate Professor, Ph.D.
Philander, S.G.H., Ph.D., Visiting Lecturer with rank of Associate Professor

Fels, S.B., Ph.D., Lecturer
Gordon, C.T., Ph.D., Lecturer
Mellor, G.L., Ph.D., Associate Faculty with Mechanical and Aerospace Engineering

To obtain further information, address inquiries to:

Professor Sheldon Judson, Chairman
Department of Geological and Geophysical Sciences
Princeton University
Princeton, New Jersey 08544

RICE UNIVERSITY
Houston, Texas 77001

Rice's current activities in marine science range from wetlands research in the nearshore environment to open ocean micropaleontological, sedimentological and geophysical research. Most of the activity is in the Gulf of Mexico, Caribbean, and the Antarctic, but problems from around the world are underway and others planned. The Department of Geology is equipped with laboratory facilities and oceanographic instrumentation mainly for programs in oceanic micropaleontology (studies on Radiolaria and Foraminifera), trace fossil studies, coral studies, land use studies, and marine geophysics. To this end the facilities in the Geology Department include two sedimentation labs, a micropaleontology lab with all major microfossil catalogues, a paleobiology laboratory, and a geophysics laboratory. These labs are adequately equipped, and marine collecting equipment includes a variety of plankton collecting devices, coring equipment, geophysical equipment, etc. The University does not maintain a research vessel but ship time is customarily available on a variety of research vessels operated by other institutions, and a number of cooperative projects with government agencies and universities are currently underway. The Department of Biology is active in wetlands and estuarine research and is equipped for such undertakings. The Department of Mechanical Engineering is active in ocean engineering research problems and is equipped for such undertakings.

The following degrees are offered:

1. B.S. in Mechanical Engineering with option in Ocean Engineering, through the Department of Mechanical Engineering.

   a) One hundred and thirty-four semester hours total
   b) At least 42 semester hours on an advanced level (300 or higher)
   c) Two years math, one year physics, and one year chemistry plus recommended courses
   d) Thirty recipients in 1978-1979 (total), two in the Ocean Engineering option

2. M.S. in Mechanical Engineering with option in Ocean Engineering, through the Department of Mechanical Engineering.

   a) Fifth-year program
   b) Ten advanced courses (300 or higher), at least four courses 500 or above and four for additional professional concentration
   c) Eight recipients in 1978-1979 (total), none in the Ocean Engineering option

3. Ph.D. in Mechanical Engineering with option in Ocean Engineering, through the Department of Mechanical and Aerospace Engineering.

   a) Normally three or more years of study are required
   b) At least two years of full-time study, or the equivalent of 60 semester hours in residence at Rice
   c) Pass public oral exam
   d) Approved thesis
   e) Four recipients in 1974-1975 (total), none in the Ocean Engineering option

4. M.A. in Geology, through the Department of Geology.

   a) Thirty semester hours, 24 of which must be in residence at Rice (includes thesis)
   b) Thesis and thesis defense
   c) Seven recipients during 1978-1979

5. Ph.D. in Geology, through the Department of Geology.

   a) Sixty semester hours, in residence at Rice (includes thesis)
   b) Language
   c) Candidacy exam
   d) Thesis and thesis defense
   e) Five recipients during 1978-1979

6. M.A. in Biology, through the Department of Biology. (Same as above in Geology; eight recipients during 1974-1975.)

7. Ph.D. in Biology, through the Department of Biology. (Same as above in Geology; eight recipients during 1974-1975.)

UNDERGRADUATE COURSES
(a = first semester, b = second semester)

Geol 332b	Sedimentation	4
Geol 341a	The Oceans	3
Geol 401b	Stratigraphy	4
Geol 405a	Micropaleontology	4
Geol 417	Physical and Chemical Oceanography	4
Geol 418b	Geological Oceanography	4
Geol 419b	Biological Oceanography	4
Geol 441a	Introduction to Geophysics	4
Geol 461a	Geophysics	4
Geol 462b	Geophysics	4
Geol 481a, 482b	Research in Marine Geology and Oceanography	Variable

GRADUATE COURSES

Biol 563a	Marshland and Estuarine Biology	3
Biol 564b	Marshland and Estuarine Biology	3
Geol 504a	Environmental Stratigraphy	4
Geol 519a, 520b	Seminar in Geophysics	3
Geol 521a, 522b	Seminar in Paleontology and Stratigraphy	3
Geol 527a, 528b	Seminar in Marine Geology, Oceanography and Micropaleontology	3
Geol 537a	Advanced Sedimentary Petrology	4
Geol 561a, 562b	Advanced Topics in Geophysics	4
Geol 574b	Electron Microprobe-Scanning Electron Microscope-Theory	2
Geol 597a, 598b	Research in Marine Geology and Oceanography	Variable
Engi 571a	Ocean Fluid Dynamics	3
Engi 572b	Structural Ocean Engineering	3

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Fisher, Frank M., Jr., Ph.D., Professor
Harcombe, Paul A., Ph.D., Assistant Professor

GEOLOGY

Anderson, John B., Ph.D., Assistant Professor
Casey, Richard E., Ph.D., Associate Professor
Clark, Howard C., Ph.D., Associate Professor
Warmz, John E., Ph.D., Adjunct Professor
Wilson, James L., Ph.D., Adjunct Professor

MECHANICAL AND AEROSPACE ENGINEERING

Beckmann, Herbert W.K., D. Ing., Professor

COOPERATIVE PROGRAM IN GEOPHYSICS AND MARINE SCIENCE

A cooperative program exists between Rice University and The University of Texas, Marine Science Institute, Galveston. Programs for advanced study may be worked out by contacting either the Rice Geology Department or the Marine Science Institute, Galveston, Texas.

Supporting staff at Galveston that hold Adjunct Professorships at Rice are:

Dorman, H. James, Ph.D., Adjunct Professor
Worzel, J. Lamar, Ph.D., Adjunct Professor

To obtain further information, address inquiries to:

Dr. Jean-Claude De Bremaecker
Department of Geology
Rice University
Houston, Texas 77001

or,

Dr. Frank M. Fisher
Department of Biology
Rice University
Houston, Texas 77001

or,

Dr. J. Lamar Worzel
Galveston Geophysical Laboratory
Marine Science Institute
University of Texas
Galveston, Texas 77550

ROGER WILLIAMS COLLEGE
Bristol, Rhode Island 02809

Roger Williams College's main campus is in Bristol, Rhode Island with approximately 800 feet of shoreline on Mount Hope Bay, a portion of Narragansett Bay. A wide variety of marine environments are within 10 miles of the campus including water depths of over 150 feet, rocky ocean shorelines, tidal marshes, estuaries with a wide variety of salinities, and a wide variety of bottom types. Waters near the campus range from heavy pollution with both industrial and human waste to relatively pollution free ocean waters. Generally, small classes of six to 15 students in upper level courses make field work, laboratory work and special projects an important part of the curriculum. A paper or other evidence of the student's ability to conduct investigations, use library resources and write a report is usually required in each upper level course.

Physical facilities used by students taking courses related to marine science include six laboratories, one preparation room, one instrument and storage room, a dark room, an audio-tutorial laboratory and numerous classrooms and lecture halls, a library, dining hall and dormitories. Staff members include scuba divers and a licensed boat captain. The Marine program utilizes a 20-foot john boat for most laboratory investigations. Equipment includes various mesh size plankton nets, seines, NMR, atomic absorption unit, spectrophotometers, microscopes including binocular phase types, water sampling equipment, three small refrigerated sea water tanks, photographic equipment, a flame photometer, refrigerated centrifuge, electrophoresis and chromatography equipment, pH meters, environmental chambers and a gas chromatograph. A new micro computer has been added for student use in their interpretation of data.

The following degrees are offered:

1. B.A. and B.S. degree in Biology with an opportunity to concentrate in molecular and cellular, organ and organismal biology, field biology, and horticulture. In addition to the all college core requirements, a student receiving this degree would complete:

a) Two semesters of Introductory Biology
b) Six upper-level courses in Biology
c) Two semesters of General Chemistry
d) Two semesters of Organic Chemistry
e) Two semester of Physics
f) One course entitled Communications in the Biological Sciences

2. The B.A. or B.S. degree in the Marine Sciences would require in addition to all of the college core requirements the following:

Biology	101	Introductory Biology	4
Biology	102	Introductory Biology	4
Biology	220	Marine Zoology	4
Biology	320	Marine Ecology	4
Biology	355	Marine Phycology	4
Biology	360	Freshwater and Estuarine Ecology	4
Biology	335	Invertebrate Zoology	4
Biology	210	Botany	4
Chemistry	191	General Chemistry	4
Chemistry	192	General Chemistry	4
Chemistry	301	Organic Chemistry	4
Chemistry	302	Organic Chemistry	4
Physics	201	Physics	4
Physics	202	Physics	4
Biology	201	Communications in the Biological Sciences	3

Individuals that desire the B.S. degree must complete Calculus II and Statistics.

Courses that are offered which support the Marine Science program include the following:

Biology	240	Ecology	3
Physics	245	Meteorology	3
Physics	230	Physical Oceanography	3
Biology	230	Microbiology	4
Biology	321	Genetics	4
Chemistry	101	Environmental Chemistry	4
Chemistry	102	Environmental Chemistry	4
Biology	206	Principles of Oceanography	3

Co-op Programs: Cooperative Education programs are available to students. In the past several years, individuals have been working under the Co-op Program with National Marine Fisheries; state and local environmental groups and various industries. The student has found that the field experience has been of extreme value while obtaining college credit.

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Ficorilli, George, Ph.D.
Gould, Mark, Ph.D.
Holstein, Thomas Jr., Ph.D.

Jungwirth, Charles, M.S.
Mershon, William R., MAT. Lcdr., USN (Ret.)
Murphy, Grayson, M.S.
Villalard-Bohnsack, Martine, Ph.D.

CHEMISTRY

Kendrow, Carolyn, Ph.D.
Munger, James, M.S.
Von Riesen, Daniel, Ph.D.

PHYSICAL SCIENCE

Payson, Harold, M.S., Capt. USN (Ret.)

To obtain further information, address inquiries to:

Mark D. Gould, Ph.D.
Natural Science Division
Roger Williams College
Bristol, Rhode Island 02809
(401) 255-2165

RUTGERS - THE STATE UNIVERSITY OF NEW JERSEY
New Brunswick, New Jersey 08903

Modern laboratory facilities in the basic sciences are available on the three city campuses at New Brunswick, Camden, and Newark, New Jersey. In addition, the University operates several small laboratories on the New Jersey coast involved with various aspects of shellfish research and a larger laboratory on Great Bay which is designed to work on the full range of marine inquiry. A 62-foot research vessel was recently acquired and will work out of the Great Bay station. A 40-foot research vessel, based at one of the laboratories on Delaware Bay, operates year-round, providing facilities for power dredging, hydrographic sampling, etc. within the estuary. A small fleet of outboards is available for a variety of studies in the coastal bays and sounds, throughout the length of the State. An ancient houseboat laboratory is another base for summer work in one of the estuaries. The research programs underway in these laboratories provide coastal marine experiences for approximately 25 students annually.

Undergraduate students planning to do advanced work in the marine sciences usually major in one of several undergraduate degree programs such as Biology, Geology, Environmental Science, Chemistry, etc. In addition to satisfying requirements for their major, these students may elect one or more undergraduate courses from the list below.

At the graduate level no degree program is specifically labeled "marine", but graduate students in Ph.D. programs in Zoology, in Botany, in Environmental Science, in Ecology, in Microbiology, or in Geology, etc. can gain marine experience in the coastal research programs underway here.

A new Ph.D. program in Geophysical Fluid Dynamics is now offered through the cooperative efforts of the Department of Mechanical and Aerospace Engineering and the Department of Meteorology. Teaching and research concentrate on fluid dynamics problems of the geosphere, i.e., on meteorological and oceanographic fluid dynamics and related problems. The program draws on research and graduate courses in the fields of meteorology, engineering, mathematics, information sciences and others as necessary. Specializations available within the program include meteorology, physical oceanography, upper atmosphere dynamics, air pollution, turbulence, turbulent dispersion and rotating and stratified flow.

Students select from courses in meteorology, physical oceanography, mechanical and aerospace engineering and related graduate offerings.

Rutgers has established the Marine Sciences Center as a research arm of the University. The Center will interact with the variety of departments on campus but will not develop its own curriculum at this time. Rather, faculty and students will work through the Marine Sciences Center while retaining their affiliation with their academic departments.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Agricultural Engineering

381	Introduction to Environmental Systems Analysis
382	Techniques of Environmental Systems Analysis

Bacteriology

432	Applied Bacteriology

Biology

212	The Ecology of Marine Life
351	General Ecology
415	Marine Ecology
416	Marine Ecology Laboratory

Botany

306	Plant Ecology
411	Algae: Morphology and Taxonomy
434	Morphology and Taxonomy of Algae
436	Physiology and Ecology of Algae

Chemical and Biochemical Engineering

303, 304	Transport Phenomena

Environmental Science

403	Introduction to Air and Water Environment
404	Aquatic Biology
444	Water Resources - Water Quality

Food Science

103	Man and His Food

Geography

101, 102	Man's Physical Environment
211	Conservation of Natural Resources
407	Remote Sensing of Earth Resources
410	Ocean Trade and Transportation
417	Coastal Geomorphology

Geology

102	Oceanography and Earth History
331	Oceanology
340	Sedimentology
451	Geology of Ocean Basins
453	Paleoecology

Mechanical and Aerospace Engineering

351	Thermodynamics

Meteorology and Physical Oceanography

251	Elements of Oceanography
352	Coastal Estuarine Oceanography
362	Physical Oceanography
364	Oceanographic Analysis
455	Oceanographic Instrumentation
458	Air-Sea Interaction
461, 462	Dynamic Oceanography

Microbiology

418	Marine Microbiology
420	Laboratory in Marine Microbial Ecology
432	Practical Applications of Microbiology
496	Microbial Ecology

Physiology

306	Comparative Animal Physiology

Zoology

406	Limnology

GRADUATE COURSES

Agricultural Engineering

507	Environmental Systems Analysis
541	Biological Aspects of Stress

Anthropology

567	Dynamics of Social and Ecological Systems

Biochemistry

511	Plant Biochemistry
524	Biochemical Adaptation to Unusual Environments

Biology

505	Marine Biology
511	Ichthyology
525	Limnology

Botany

507	Biogeography and Comparison of Ecosystems
534	Phycology
536	Algal Physiology
542	Physiological Ecology

Ceramic Science and Engineering

522	Scanning Electron Microscopy and X-ray Micro-Analysis

Chemical and Biochemical Engineering

502	Fluid Momentum and Energy
533, 534	Advanced Chemical Engineering Thermodynamics
587	Applied Kinetics and Thermodynamics for Enzymatic Processes
581	Biochemical Engineering

Chemistry

537, 538	Chemistry of Natural Products

Civil and Environmental Engineering

563	Advanced Hydrology
573	Advanced Soil Mechanics
583	Hydromechanics
578	Soil Dynamics
588	Theory of Hydraulic Models
590	Coastal Engineering

Entomology and Economic Zoology

504	Mosquito Biology and Control
522	Toxicology of Economic Poison

Environmental Science

501	Waste Treatment I: Sewage Treatment
502	Stream Sanitation
503	Environmental Chemistry and Analysis
507	Principles of Aquatic Chemistry
510	Pollution Microbiology
511	Ichthyology
512	Ichthyology and Fishery Management
514	Application of Aquatic Chemistry
517, 518	Principles of Environmental Science

Food Science

513	Advanced Food Science

Geography

501	Natural Resource Management
504	Coastal Geomorphology
507	Environmental Management
509	Problems in Port Geography

Geology

514	Advanced Sedimentary Petrology
526	Planktonic Foraminifera
532	Geochemistry

553, 554	Micropaleontology: Foraminifera
570	Marine Geology

Geophysical Fluid Dynamics

501	Fluid Dynamics of the Atmosphere
611	Seminar in Geophysical Fluid Dynamics

Mechanical and Aerospace Engineering

515, 516	Fluid Dynamics
517, 518	Heat and Mass Transfer
539	Mechanics of Real Fluids
621	Theory of Turbulence
622	Atmospheric Turbulence
651	Power Plants

Meteorology and Physical Oceanography

501	Micrometeorology
508	Dynamic Climatology

Microbiology

501, 502	General Microbiology
572	Microbial Ecology

Physiology

507	Comparative Physiology
520	Environmental Physiology
531	Advanced Nerve and Muscle Physiology

Plant Biology

505, 506	Plant Physiology

Soils and Crops

563	Clay Minerology
565	Clay Minerology Laboratory
553	Soil Physics

Statistics

506	Statistical Analysis of Biological Systems

Urban Planning

523	Legal Aspects of Environmental Planning
618	Environmental Planning and Management

Zoology

504	Elements of Oceanography
505	Malacology
506	Ecology of the Estuary
507	Immunity of Animal Parasites
522	Protozoology
523	Zoogeography
571	Radioecology
575	Quantitative Ecology
580	Topics in Marine Ecology
588	Topics in Advanced Ecology
590	Population Ecology

The instructional staff for the courses listed above consists of the following members:

AGRICULTURAL CHEMISTRY

Helrich, Kenneth, Research Professor
Rosen, Joseph D., Ph.D., Associate Research Professor
Winnett, George, Ph.D., Professor

ANIMAL SCIENCE

Hackett, A.J., Ph.D., Assistant Professor
McGrath, James J., Ph.D., Associate Professor

BACTERIOLOGY

Koft, Bernard W., Ph.D., Professor
Kuchler, Robert, Ph.D., Professor
Litchfield, Carol, Ph.D., Associate Professor
Umbreit, W., Ph.D., Professor

BIOCHEMISTRY AND MICROBIOLOGY

Bartha, Richard, Ph.D., Associate Research Professor
Eveleigh, Douglas, Ph.D., Associate Professor
Litchfield, Carter, Ph.D., Associate Professor
Pramer, David, Ph.D., Professor
Price, Carl, Ph.D., Professor

BIOLOGY

Burger, Joanna, Ph.D., Assistant Professor
Jenkins, Robert, Ph.D., Professor
Lee, Hsin-Yi, M.S., Assistant Professor
Weiss, Mitchell, Ph.D., Assistant Professor

BIOLOGICAL RESEARCH

Squibb, Robert L., Ph.D., Professor

BOTANY

Chen, James C.W., Ph.D., Associate Professor
Edwards, Peter, Ph.D., Assistant Professor
Good, Ralph E., Ph.D., Associate Professor
Quinn, James A., Ph.D., Associate Professor

CHEMICAL AND BIOCHEMICAL ENGINEERING

Ahlert, Robert C., Ph.D., Professor
Davidson, Burton, Ph.D., Professor
Dittman, Frank W., Ph.D., Professor
Vieth, Wolf, Ph.D., Professor

CHEMISTRY

Bikales, Norbert, Ph.D., Professor
Hall, Stan, Ph.D., Associate Professor

CIVIL AND ENVIRONMENTAL ENGINEERING

Bourodimos, E.L., Ph.D., Associate Professor
Chae, Yong S., Ph.D., Professor
Granstrom, Marvin, Ph.D., Professor

ECONOMICS

Seneca, Joseph, Ph.D., Professor

ELECTRICAL ENGINEERING

Rosenthal, Louis A., M.E.E., Professor

ENTOMOLOGY AND ECONOMIC ZOOLOGY

Forgash, Andrew, Ph.D., Professor
Hansens, Elton J., Ph.D., Research Professor
Helrich, Kenneth, M.S., Research Professor
Jobbins, Daniel M., M.S., Research Specialist
Merrill, Leland, Ph.D., Professor

ENVIRONMENTAL EDUCATION

Edwards, Arthur, Ph.D., Associate Professor

ENVIRONMENTAL RESOURCES

Mitchell, J. Kenneth, Ph.D., Associate Professor
Nieswand, George H., Ph.D., Assistant Professor
Walton, Grant, Ph.D., Professor
Whipple, William, Jr., C.E.

ENVIRONMENTAL SCIENCE

Clements, William, Ph.D., Assistant Research Professor
Faust, Samuel D., Ph.D., Research Professor

FOOD SCIENCE

Chang, Stephen S., Ph.D., Professor
Haard, Norman F., Ph.D., Assistant Professor
Hayakawa, Kan-Ichi, Ph.D., Associate Professor
Maclinn, Walter A., Ph.D., Professor
Morse, Roy C., Ph.D., Professor
Solberg, Myron, Ph.D., Professor

FORESTRY

Applegate, James, Ph.D., Assistant Professor

GEOGRAPHY

Nordstrom, Karl, Ph.D., Assistant Research Professor
Psuty, Norbert P., Ph.D., Professor
Weigend, Guido, Ph.D., Professor

GEOLOGY

Murray, Raymond C., Ph.D., Professor
Olsson, Richard K., Ph.D., Professor
Piburn, Michael, Ph.D., Assistant Professor
Theokritoff, George, Ph.D., Associate Professor
Wiles, William W., Ph.D., Associate Professor
Younce, Gordon B., Ph.D., Assistant Professor

LAW

Frakt, Arthur, L.L.B., Professor
Seeley, James, J.D., Professor

MECHANICAL AND AEROSPACE ENGINEERING

Chen, Chuan F., Ph.D., Professor

MECHANICS AND MATERIAL ENGINEERING

Sauer, J.A., Ph.D., Professor

METEOROLOGY AND PHYSICAL OCEANOGRAPHY

Havens, A. Vaughn, M.S., Professor
Reiss, Nathan, Ph.D., Assistant Professor

MICROBIOLOGY

Gordon, Ruth E., Ph.D., Professor
Lechevalier, H.A., Ph.D., Professor

NUTRITION

Fisher, Hans, Ph.D., Professor

PATHOLOGY

McCoy, John R., Ph.D., Professor

PHARMACEUTICAL SCIENCE

Babcock, Phillip A., Ph.D., Associate Professor
Segelman, Alvin, Ph.D., Assistant Professor

PHYSIOLOGY

Bird, John W.C., Ph.D., Professor
Farmanfarmaian, A., Ph.D., Professor
Senft, Joseph P., Ph.D., Associate Professor

PLANT BIOLOGY

Halisky, Philip M., Ph.D., Associate Professor

PLANT SCIENCE

Dawson, Ray F., Ph.D., Professor
Karmas, Endel, Ph.D., Assistant Professor

SOCIAL SCIENCE AND HUMAN ECOLOGY

Friedman, Judith, Ph.D., Assistant Professor
McCay, Bonnie, M.S., Assistant Professor
Schuh, Janet, Ph.D., Assistant Professor

SOILS AND CROPS

Battle, Warren R., Ph.D., Professor
Duell, Robert W., Ph.D., Associate Research Professor
Tedrow, John C.F., Ph.D., Professor
Toth, Stephen J., Ph.D., Professor

STATISTICS

Andrews, Horace P., Ph.D., Associate Professor

URBAN STUDIES

Greenberg, Michael, Ph.D., Associate Professor

ZOOLOGY

Durand, James B., Ph.D., Professor
Ehrenfeld, David, Ph.D., Associate Professor
Gardiner, Lion F., Ph.D., Assistant Professor
Haskin, Harold, Ph.D., Professor
Hastings, Robert, Ph.D., Assistant Professor
Leck, Charles F., Ph.D., Assistant Professor
Loveland, Robert E., Ph.D., Associate Professor
Pearson, Paul G., Ph.D., Professor
Trama, Francesco B., Professor
Weis, Judith S., Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. Norbert P. Psuty, Director
Marine Sciences Center
Rutgers - The State University of New Jersey
New Brunswick, New Jersey 08903
(201) 932-3080

ST. JOHN'S UNIVERSITY
Jamaica, New York 11439

The University offers marine science courses at the Queens campus. The science building opened in 1958. The departments of biology, chemistry and physics and the College of Pharmacy are located in this building which contains complete laboratory and classroom facilities for instruction and research. The marine waters of Long Island Sound, Jamaica Bay, Great South Bay and the Atlantic Ocean are easily accessible for collecting samples and specimens.

The following degrees are offered:

1. Ph.D. in Biology (Department of Biology). The course requirements are determined by a special faculty committee on the basis of the professional objectives of the individual student. A minimum of 69 semester hours of graduate coursework beyond the bachelor's degree or a minimum of 36 semester hours beyond the master's degree must be taken in the program. The student must also demonstrate an ability to read two of the following languages: French, German or Russian.

2. M.S. in Biology (Department of Biology). A minimum of 33 semester hours of graduate courses beyond the bachelor's degree must be taken in the program. At present there is no formal dissertation or language requirement for this degree.

3. B.S. in Biology; B.S., B.A. in Environmental Studies. This is the regular program for biology majors who may elect to take some courses and research in marine biology and related subjects.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

23	Invertebrate Zoology	4
33	Marine Biology	4
37	Ecology	4
40, 41	Research in Biology	4
42	Biology of Selected Protists	4

GRADUATE COURSES

205, 206	Microbial Physiology	6
226	Marine Microbiology	3
246, 247	Marine and Fresh Water Invertebrates	6
352, 353 354, 355	Special Research in Biological Sciences	12
950	Dissertation Research	6

(Other graduate courses in microbiology, biochemistry and physiology are available to complete the specialized programs of individual students.)

To obtain further information, address inquiries to:

Chairman
Department of Biology
St. John's University
Grand Central and Utopia Parkways
Jamaica, New York 11439

SAN DIEGO COMMUNITY COLLEGES
Mesa College, San Diego, California 92112
Evening College, San Diego, California 92101

These colleges each offer a two-year program leading to either an Associate Science degree or certificate in Marine Technology. Shop facilities are utilized for practical instruction in refrigeration, welding, propulsion machinery, drafting and other allied industrial arts that have relevance to marine work. Biological, physical and chemical laboratories are used for class work needed to develop skills related to basic tasks needed in the marine environment. Initially, instruction began in 1967 and the full program began in 1969. A wide range of marine science, ocean engineering and business enterprises are carried on in San Diego, and many of these are frequently visited in the course of field trips. Vessels are chartered for all-day at-sea instruction. A shoreside technology institute jointly administered by a countywide alliance of higher education institutions is to be designed in 1984.

The following courses are offered in conjunction with the above programs:

MARINE TECHNOLOGY

Marine Environment	3
Equipment Operations	3
Marine Resources	3
Marine Communications	3
Marine Equipment	3

The instructional staff for the courses listed above includes the following:

Eberhardt, Robert L., M.S., Instructor in Marine Technology

To obtain further information, address inquiries to:

Walter DeFelice, Jr., Coordinator
Vocational Education
San Diego Community College District
3375 Camino del Rio South
San Diego, California 92108

SAN FRANCISCO STATE UNIVERSITY
San Francisco, California 94116

The Lake Merced campus of San Francisco State University houses a complete and modern educational community. In addition to the well-equipped classrooms and laboratories, there are numerous specialized instructional rooms, a large library and audio-visual center, two theatres and a wide range of recreational and athletic facilities. Recently completed buildings greatly enhance the University's capabilities in the science disciplines. Building in the planning stages will include more classroom space for the humanities and education. In addition to activities at its San Francisco site, the University participates in three off-campus activities: The Tiburon Center for Environmental Studies, the J. Paul Leonard Sierra Nevada Science Field Campus, and the Moss Landing Marine Laboratories. The University also operates an extension program serving more than 3,000 students as well as conducting short courses, conferences, institutes and workshops.

The following degrees are offered:

1. Master of Arts in Biology: Concentration in Marine Biology. The general requirements of all students are as follows:

a) Thirty units of upper division and/or graduate credit (may include up to six units of experimental courses in Biology).

b) A minimum of 16 units of credit in graduate-level courses.

c) A minimum of two department seminars.

d) Graduate English Proficiency Test: this requirement may be met by satisfactory completion of Biology 700.

e) After initiating a research program, a graduate student must enroll each semester in Biology 897 or 898 (for which a student can only be enrolled once) until the research is completed or the graduate Approved Program is filed. In the absence of course conflicts, each graduate student must enroll in at least one graduate course per semester, excluding Biology 897 or 898.

Alternate 1: M.A. by research and thesis.

a) Students who elect this program must complete a minimum of three and a maximum of six units of Biology 897 to be counted toward the 30 required units.

b) Four units of Biology 898, thesis.

c) An oral defense of the thesis research.

Alternate 2: M.A. by research and examinations

a) A maximum of four units of Biology 897, research.

b) A written examination taken during the student's first or second semester. This examination may be repeated with a three-semester time limit for satisfactory passage.

c) A comprehensive oral examination. If portions of this examination are unsatisfactory, they may be repeated one time. Students wishing to elect Alternate 2 must follow the procedural guideline formulated by the Biology Graduate Committee. These are available from the Biology Graduate Advisors.

GENERAL INFORMATION

The Marine Biology Program offers the Master of Arts degree in Biology with a concentration in Marine Biology. Programs in this area reflect the fact that Marine Biology is a meeting place for all the biological sciences and some of the physical sciences. Graduate work may be broad or follow specific program areas as ecology, systematics, functional morphology, physiology and ethology.

The marine program and facilities of San Francisco State University are strongly supported by the Moss Landing Marine Laboratories, a modern seashore laboratory which is operated cooperatively with four other State Universities.

Students interested in study through this program are urged to observe the general requirements in the Bulletin as well as the specific requirements stated here and, more fully, in the Marine Biology catalog which is available from the Program Office upon request.

The applicant must have the equivalent of the Bachelor of Arts degree in the Department of Marine Biology at San Francisco State University or the approval of the Marine Biology advisor.

2. Master of Arts in Geography. Program requirements for the Master of Arts degree in Geography are as follows:

Geog. 801	Scope and Method in Geography (Should be taken by the student during the first year after admission to the program)	3

Three graduate seminars in Geography from the following (one semester may be repeated for credit if a different topical area is offered by a different instructor):

810 Seminar in Physical Geography	3
820 Seminar in Cultural Geography	3
825 Seminar in Economic Geography	3
832 Seminar in Urban Geography	3
850 Seminar in Regional Geography	3
Upper division courses or graduate seminars in Geography or related fields on advisement:	15
898 Master's Thesis	3
Minimum Total (and Master's Oral Examination (if failed, examination may be repeated only once))	30

The following courses are offered in conjunction with the above programs (upper division courses offered by the Department may be considered upon approval of the graduate advisor):

GRADUATE COURSES

801 Scope and Method in Geography	3
810 Seminar in Physical Geography	3
820 Seminar in Cultural Geography	3
825 Seminar in Economic Geography	3
832 Seminar in Urban Geography	3
850 Seminar in Regional Geography	3
895 Directed Reading in Geography	3
898 Master's Thesis	3
899 Special Study	1-3

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Araki, G., Ph.D., Professor
Berrend, R., Ph.D., Associate Professor
Bradbury, M., Ph.D., Professor
Josselyn, M., Ph.D., Assistant Professor
Martin, J.H., Ph.D., Professor
Niesen, T., Ph.D., Associate Professor
Tomlinson, J., Ph.D., Professor
Towle, A., Ph.D., Professor
Yonenaka, H., Ph.D., Professor

GEOLOGY

Galehouse, J., Ph.D., Professor
Kelley, J., Ph.D., Professor
Seibel, E., Ph.D., Professor

GEOGRAPHY

Crawford, R., Ph.D., Associate Professor
Foster, L., Ph.D., Professor
Gordon, B., Ph.D., Professor
Hough, R., Ph.D., Professor
Kirkeberg, M.S., Assistant Professor
Meihoefer, H., Ph.D., Professor
Pease, S., Ph.D., Assistant Professor
Picker, R., Ph.D., Professor
Treichel, G., M.A., Associate Professor
Vance, J., Ph.D., Professor
Westfall, J., Ph.D., Professor

MARINE SCIENCE

Arnal, R., Ph.D., Professor
Broenkow, W., Ph.D., Associate Professor
Cailliet, G., Ph.D., Assistant Professor
Foster, M., Ph.D., Associate Professor
Hurley, A., Ph.D., Assistant Professor
Knauer, G., Ph.D., Research Associate
Martin, J., Ph.D., Associate Professor
Morejohn, G., Ph.D., Professor
Nybakken, J., Ph.D., Professor
Recksiek, Ph.D., Research Associate

To obtain further information, address inquiries to:

Dr. James C. Kelley, Dean
School of Science
San Francisco State University
San Francisco, California 94132

SANTA BARBARA CITY COLLEGE
Santa Barbara, California 93109

The recently completed Santa Barbara City College Marine Diving Technician building is located on the SBCC main campus. The facilities include office space, shop space housing a variety of diving and diving support equipment including an operational saturation diving system, two 12-foot by 12-foot diver training tanks, and a rigging loft. The program has one 16-foot Boston Whaler with an outboard motor and utilizes rental boats for part of the training.

Successful completion of the two-year Marine Diving Technician Program qualifies graduates for a Certificate of Completion or an A.S. Degree and employment in a variety of jobs mainly centered in the commercial diving industry.

The following courses are offered in conjunction with the above program:

First Semester

Seamanship and Small Boat Handling	3
Basic Diving (Scuba and Hookah)	3
Marine Drafting (Drawing and Blueprint Reading)	3
Basic Welding	2
Technical Report Writing	3

Second Semester

Advanced Diving	3
Fundamental of Marine Engines and Compressors	3
Marine Welding	2
Physical Oceanography for Diving Technology	4
Marine Biology	3

Third Semester

Underwater Construction	3
Biological Oceanography	3
Technical Physics	4
Fundamentals of Electronics	3
Machine Shop Operations	4

Fourth Semester

Underwater Operations	3
Diving Systems	3
Emergency Medical Technician I	3
Speech	3
American Institutions Class	3

The instructional staff for the courses listed above consists of the following:

Christensen, Robert W.
Clouser, Gerald L.
Parks, Ramsey, Department Chairman

To obtain further information, address inquiries to:

Ramsey Parks, Department Chairman
721 Cliff Drive
Santa Barbara, California 93109
(805) 965-0581, ext. 426

SEATTLE CENTRAL COMMUNITY COLLEGE
Seattle, Washington 98107

The Marine Technology Department of Seattle Central Community College is located on a two-acre site on the Lake Washington Ship Canal in the heart of the maritime community. Our facilities consist of a 1,260-ton training ship, the S/S Trident, and a 70-foot tug, the TD-82, which is used for underway training. It also includes a shop and classroom facilities aboard a barge, along with various shoreside facilities.

At the present time, we have three full-time instructors and nine part-time instructors.

Our program emphasizes the practical training necessary for the efficient operation and effective maintenance of power plants and auxiliary machinery aboard sea-going vessels with heavy emphasis on marine engineering training. We are branching into the deck area as funds permit, while serving the fishing, towboat, and offshore segments of the marine industry. We have a well-equipped diesel, refrigeration, machine shop and electrical shop areas.

Our two-year degree program requires 90 credit hours and is fully accredited. In addition to the above degree program, we offer towboat and tankermen training courses. Involved in the degree program are over 100 students and an additional 125 are enrolled in our continuing education program. There were 15 students receiving their Associate of Applied Science Degree in Marine Technology this past year.

We are participating in the technician training aspect of the Sea Grant Program with the University of Washington.

The following courses are offered in conjunction with the above program:

MARINE ENGINEERING TECHNOLOGY ASSOCIATE DEGREE

First Quarter

ENG 105	Communication Skills	3
MTE 101	Engine Department Maintenance	4
MTE 111	Marine Electricity	4
MTE 131	Boilers	2
MTE 143	Applied Mathematics for Marine Technology	3
		16

Second Quarter

ENG 106	Communication Skills	3
MTE 112	Marine Electricity	4
MTE 122	Marine Hydraulics	3
MTE 132	Boilers	2
MTE 144	Applied Mathematics for Marine Technology	3
MTE 151	Reciprocating Engines	2
		17

Third Quarter

Approved	General Education Elective	3
MTE 102	Auxiliary Machinery	4
MTE 123	Marine Hydraulics	3
MTE 171	Diesel Engines	3
MTE 181	Basic Marine Refrigeration	3
		16

Fourth Quarter

Approved	General Education Elective	3
MTE 106	Ship's Machine Shop Practice	2
MTE 241	Gas Welding	3
MTE 251	Turbine Engines	3
MTE 271	Diesel Engines	4
		15

Fifth Quarter

Approved	General Education Elective	3
MTE 242	Arc Welding	3
MTE 252	Turbine Engines	3
MTE 272	Diesel Engines	3
MTE 293	Instrumentation	3
		15

Sixth Quarter

Approved	General Education Elective	3
MTE 145	Small Boat Handling	4
MTE 148	Ship's Medical Practice	2
MTE 281	Marine Refrigeration Systems	4
MTE 290	Coast Guard Rules and Regulations	3
		16

PSY 220	Psychology of Human Relations	3
SSC 250	American Institutions	3
		6

The instructional staff consists of the following:

Dahlgren, Henry K., Chief Engineer
Rambeau, Morris, Chief Engineer
Smith, Donald W., M.B.A., Department Chairman

Part-time instructors:

All part-time instructors hold engineers licenses or are masters in their particular field.

Ayres, Kenneth, Admiral (Ret.)
Campion, Robert
Gaddy, Robert
Jacobson, Russell
Jenkins, Charles
Jones, Daniel
Raymond, Richard
Spees, Charles
Zandee, Peter

To obtain further information, address inquiries to:

Donald W. Smith
4455 Shilshole Avenue, N.W.
Seattle, Washington 98107
(206) 587-3884

SEATTLE PACIFIC UNIVERSITY
Seattle, Washington 98119

The University offers Marine Biology courses at its main campus in Seattle, Casey Campus on Whidbey Island and at its field station on Blakely Island. The Casey Campus encompasses more than 100 acres of wooded lands, with a mile of private beach facing the straits of Juan de Fuca. Accommodations include barracks, kitchen and dining facilities, classrooms and a seawater laboratory. A small field station with laboratory, dining and housing facilities for 25 students and faculty is under development. The field station will be used for research and field studies in Marine Biology. Summer programs in Marine Biology are offered each year. The Casey Campus is used extensively by public schools during the academic year for outdoor education programs.

The B.S. in Biology is offered by the University. All students are required to take general Biology (1111, 1112 and 1113), Genetics (Biology 3325), Ecology (Biology 3310), Developmental Biology (3320), Cell Biology (4352), Seminar (4935) and 20 additional quarter hours in upper-division Biology. Chemistry through organic is required.

The following courses provide the basis for a B.S. in Biology with a marine emphasis:

BIOLOGY

4256	Environmental Physiology	5
4738	Marine Biology	5
4740	Marine Invertebrate Zoology	5
4744	Marine Botany	5
4950A	Marine Problems	3
4950B	Tropical Marine Biology	3
4900	Marine Natural History of the San Juan Islands	3

The instructional staff for the courses listed above consists of the following:

Moore, A.K., Ph.D., Environmental Physiology
Phillips, Ronald, Ph.D., Marine Botany and Ecology
Russell, Dennis, Ph.D., Marine Botany and Mariculture
Shaw, Ross F., Ph.D., Marine Invertebrate Zoology and Marine Ecology

To obtain further information, address inquiries to:

Dr. Ross F. Shaw, Director
Marine Biology Program
Seattle Pacific University
Seattle, Washington 98119

SHELDON JACKSON COLLEGE
Sitka, Alaska 99835

Sheldon Jackson College has marine science teaching facilities on its campus located at Sitka on Baranof Island in Southeast Alaska. The physical facilities include a freshwater-seawater laboratory and indoor and outdoor salmon hatchery incubation capacity for 12 million eggs or alevins. Physical, chemical and biological sciences share the same building located on the Pacific seashore as well as modern teaching laboratories built and equipped within the last four years. In addition, the College owns a 38-foot, twin engine cabin cruiser, an 18-foot Boston Whaler with an 80 horsepower outboard motor, a 16-foot Livingston with 80 horsepower outboard motor, and several smaller skiffs. Numerous teaching and research equipment is available for study of marine and freshwater environments. Practical experience is emphasized in the hatchery and field technician training courses for fisheries students.

The following degrees are offered:

1. A.S. in Science specializing in Marine Biology.
   a) Two years, 64 semester credits.
2. A.S. in Science specializing in Fisheries Technology.
   a) Two years, 64 semester credits.
3. Two-year Certificate in Fisheries Technology.
   a) Two years, 49 semester credits.
   b) Includes requirements of one-year certificate

4. One-year Certificate in Fish Culture Technology.

a) One year, 25 credits.
b) Includes late summer salmon spawning experience.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Bio 113	Introduction to Biology	4
Bio 202	Fundamentals of Ecology	3
Bio 211	General Botany	4
Bio 213	General Zoology	4
Bio 222	Introduction to Marine Biology	4
Fish 100, 101, 102	Hatchery Practicum	3
Fish 111	Fish Husbandry I	4
Fish 112	Fish Husbandry II	4
Fish 114	Fish Biology	4
Fish 200	Fish Science	4
Fish 202	Field Project	4
Fish 250	Fish Pathology	4
Tech 114	Small Engine Repair	2

The instructional staff for the courses listed above consists of the following:

BIOLOGY

RaLonde, Ray, B.S.
Reller, Carl, B.S.

FISHERIES

Lund, Dennis, M.S.
Seifert, Mel, M.S.

To obtain further information, address inquiries to:

Dr. Charles Bovee, Academic Dean and Vice President
Box 479
Sheldon Jackson College
Sitka, Alaska 99835

SHORELINE COMMUNITY COLLEGE
Seattle, Washington 98133

Shoreline Community College has a complete two-year Oceanography and Marine Science Technology Program. Our facilities, which consist of two laboratory spaces at the present, and which will be expended to a new facility in 1981, are located at the main campus site. The College also has a boat which is used in collecting samples and training students in operations.

The degree offered is Associate of Applied Arts in Oceanography or an Associate of Applied Arts in Marine Science. All courses are offered in the science division. Eighteen persons received the Associate of Applied Arts Degree in Marine Sciences in 1979. Due to the excellent job market in the area, this number is down over previous years.

The following courses are offered in conjunction with the above programs:

Bio. Sci.	143/243	Marine Biology	5
Bio. Sci.	230	Invertebrate Zoology	5
Bio. Sci.	231	Vertebrate Zoology	5
Bio. Sci.	280	Biological Techniques	5
Ocean.	101	Survey of Oceanography	5
Ocean.	170-171	Oceanographic Cruise	1-6
Ocean.	174	Underwater Photography	1
Ocean.	196	Oceanographic Laboratory and Field Technology	6
Ocean.	197	Oceanographic Laboratory and Field Technology	6

The instructional staff for the courses listed above consists of the following:

Harman, Robert, Professor, Oceanography
Lewis, Bill, Professor, Biological Sciences
Serwold, John, Professor, Biological Sciences

To obtain further information, address inquiries to:

Dr. John C. Serwold, Professor
Science Division
Shoreline Community College
16101 Greenwood Avenue North
Seattle, Washington 98133
(206) 546-4576

SOUTHEASTERN MASSACHUSETTS UNIVERSITY
North Dartmouth, Massachusetts 02747

The proximity of the University to the marine environment has resulted in a special emphasis in both faculty research and course orientation toward the estuaries and near-shore waters of the Buzzards Bay region of the Massachusetts coast. The University is also within a one-hour drive of the important libraries, museums, and research institutions of the Boston and Woods Hole areas.

The University supports several teaching and research laboratories which are completely equipped for most standard physiological and ecological analyses including gas chromatography, automated CHN analyses, scanning and transmission electron microscopy, liquid scintillation radiometry and computer analyses. Several constant temperature rooms, a greenhouse and a 63-foot oceanographic research vessel, Corsair, supplement the general laboratories. The Department also maintains active museum and herbarium collections of the fish, invertebrates, diatoms and seaweeds of the southeastern Massachusetts region.

In addition, the department is in the final planning stages of building a coastal marine laboratory within 15 miles of the North Dartmouth campus. A summer program in marine biology is being considered for the near future.

The following degrees are offered by the Biology Department at Southeastern Massachusetts University:

1. B.S. in Biology with option for a degree in either General Biology or Marine Biology and Coastal Zone Ecology.

2. M.S. in Biology.

3. M.S. in Marine Biology.

The Department of Biology offers programs leading to the Master of Science degrees in either Biology or Marine Biology under either a thesis or non-thesis program of study. Individualized programs of study reflect the research interests of the faculty. Students interested in a research career or continued graduate education may elect a program culminating in a laboratory/field research thesis. Secondary educators interested in broadening their background in biology may elect a program of study culminating in a library research paper.

The Department of Biology offers two options in its program which reflect the general research interests of its faculty: 1) a marine biology option culminating in a Master of Science with specialization in Marine Biology, and 2) a general biology option leading to a Master of Science with emphasis in one of the traditional areas of General Biology. Both options emphasize the development of fundamentals of biology by means of lectures, laboratories, field trips and seminars, and each encourages student engagement in original research leading to the Master's Thesis.

REQUIREMENTS FOR M.S. DEGREE

Each candidate will be encouraged to develop an original research problem (Research Thesis), but those who do not contemplate a career in research or further formal education can earn a degree on the basis of the successful completion of their coursework and a library research problem (Library Thesis).

1. Research Thesis. The Research Thesis is designed primarily for individuals pursuing biology as a profession. The following are minimum hours of coursework required in addition to a thesis:

a) Twelve hours (minimum) of graduate courses numbered 500 or above. Three hours of Directed Study unrelated to thesis may be allowed by the examining committee.
b) Six hours (maximum) of approved undergraduate courses numbered 300 or above.
c) Two hours (maximum, 1 hour required) of Graduate Student Seminar, BO 525.
d) Ten hours (maximum) of thesis credit and work related to the thesis (Directed Study, Graduate Research, Graduate Thesis).
e) Total of 30 hours plus successful defense of thesis.

2. Library Thesis. The Library Thesis is designed primarily for individuals pursuing a career in secondary education, and others not planning further graduate study in biology. The following are the minimum hours of coursework required in addition to library research thesis:

a) Twenty-two hours (minimum) of graduate courses numbered 500 or above. Three hours Directed Study unrelated to library problem may be allowed by the examining committee.
b) Six hours (maximum) of approved undergraduate courses numbered 300 or above.
c) Two hours (maximum, 1 hour required) of Graduate Student Seminar, BO 525.
d) Five hours (maximum) of Directed Study.
e) Total of 35 hours plus passage of a comprehensive examination.

The comprehensive examination may be written and/or oral at the discretion of the examining committee. The student shall demonstrate a satisfactory knowledge of General Biology and three of the following: Botany, Genetics, Microbiology, Physiology, Ecology, Zoology, or Statistics.

Each graduate students plans his course of study with the assistance of an advisory committee. Graduate students will be urged to complete most of their course requirements during their first year. After completion of nine credits a student will apply by petitioning his advisory committee, for degree candidacy. Degree candidacy will be granted on the recommendation of this advisory committee.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES
(Specifically related to B.S. degree in Marine Biology.)

BO 314	General Ecology	4
BO 315	Biology of Algae	4
BO 316	Descriptive Oceanography	3
BO 317	Biology of Invertebrate Animals	4
BO 321	General Microbiology	4
BO 411	Proseminar, Current Topics in Biology	3
BO 413	Biology of Fishes	4
BO 414	Comparative Physiology	4
BO 421	Developmental Biology	4
BO 424	Biology of Animal Parasites	4
BO 428	Aquaculture	3
BO 430	Design of Experiments	4
BO 440, 441	Research Project	2, 2
BO 451	Environmental Health	3
BO 454	Biology of Sharks	3
BO 471	Marine Microbiology	4
BO 479	Developmental Biology of Marine Animals	2
BO 406	Life in the Seas I	3
BO 407	Life in the Seas II	3

GRADUATE COURSES
(Specifically related to M.S. degree in Marine Biology. Graduate credit may be earned for dual numbered courses provided the student fulfills additional quantitative and/or qualitative requirements as established by the instructor. Graduate standing and consent of instructor as required for credit.)

BO 313/513	Molecular Biology	3
BO 315/515	Biology of Algae	4

BO 331/531	Advanced Genetics	3
BO 414/514	Comparative Physiology	4
BO 424/524	Biology of Animal Parasites	4
BO 428/528	Aquaculture	3
BO 434/534	Plant Physiology	4
BO 471/571	Marine Microbiology	4
BO 509	Directed Study in Biology	1-2
BO 511	Graduate Seminar in Biology	1-3
BO 512	Advanced Topics in Biology	1-3
BO 517	Advanced Biology of Invertebrate Animals	4
BO 520	Animal Behavior	3
BO 522	Experimental Embryology	4
BO 525	Graduate Student Seminar	1
BO 531	Advanced Ichthyology	4
BO 535	Analysis of Biological Data	3
BO 536	Laboratory for Analysis of Biological Data	1
BO 540	Environmental Physiology of Marine Animals	4
BO 545	Biological Oceanography	4
BO 593	Graduate Research Project	1-3
BO 599	Graduate Thesis	Not to exceed 10

The instructional staff for the courses listed above consists of the following:

Asato, Yukio, Microbiology
Campbell, Ronald A., Parasitology
Edgar, Robert K., Diatom Systematics
Freifelder, Dorothy, Microbiology
Griffith, Robert, Fish Physiology
Hatch, Walter, Invertebrate Physiology
Hoff, James G., Marine Ecology, Fish Biology
Ibara, Richard M., Fish Physiology and Marine Fisheries
Kazama, Fred, Mycology
Leamnson, Robert, Cell Biology and Fine Structure
Matsumoto, Barton A., Biological Control and Insect Ecology
Mulcare, Donald J., Developmental Biology
O'Brien, Frank, Ecology of Marine Invertebrates
Reardon, John J., Ecology of Coastal Zone and Dune Environments
Sasseville, Normand, Anatomy and Physiology
Sears, James R., Ecology and Systematics of Benthic Marine Algae
Turner, Jeff, Biological Oceanography
Wilson, Robert, Behavioral Physiology

To obtain further information, address inquiries to:

Dr. James R. Sears, Chairman
Department of Biology
Southeastern Massachusetts University
North Dartmouth, Massachusetts 02747

or,

Dr. Richard Fontera
Dean of Faculty
Southeastern Massachusetts University
North Dartmouth, Massachusetts 02747

SOUTHERN MAINE VOCATIONAL TECHNICAL INSTITUTE
South Portland, Maine 04106

Southern Maine Vocational Technical Institute is a public, two-year, co-educational institute at the post-secondary level, offering occupational curricula in a broad variety of fields.

The Marine Science Department is located on the South Portland campus, overlooking Casco Bay. Physical facilities include general classrooms and separate laboratory spaces for navigation, engineering, seamanship, chemistry, marine biology, and oceanography. The department maintains and operates a 146-foot training ship, Aqualab III, a 40-foot fishing boat and several small craft.

The following degrees are offered:

1. A.A.S. in Applied Marine Biology and Oceanography.

   a) This program requires 43 credits in biology and oceanography and 28 in related subjects.
   b) At the most recent graduation, 13 degrees were conferred.

2. A.A.S. or Diploma in Marine Science with a major in Deck Technology, Engineering Technology, or Oceanography and Marine Biology.

   a) Deck Technology requires 35 credits in navigation/seamanship and 34 related credits for an A.A.S. degree and 26 for a diploma.
   b) Engineering Technology requires 32 credits in engineering and 35 related credits for an A.A.S. degree and 27 for a diploma.
   c) Oceanography and Marine Biology, requires 33 major credits and 36 in related subjects. No diploma offered.
   d) At the most recent graduation, 36 Marine Science degrees or diplomas were conferred.

The following courses are offered in conjunction with the above programs:

APPLIED MARINE BIOLOGY AND OCEANOGRAPHY

First Semester

CHM 111	General Chemistry	4
BIO 111	General Biology	4
OCO 111	Elements of Oceanography	4

Second Semester

BIO 113	Invertebrate Zoology	4
OCO 112	Instrumentation and Methods in Oceanography	3

Third Semester

NAV 21	Survey of Navigation	3
BIO 211	Microbiology	4
OCO 211	Chemical Oceanography	4

Fourth Semester

BIO 212	Ecology	4
BIO 248	Fishery Science	4
OCO 212	Physical and Geological Oceanography	4
BIO 246	Marine Botany	4

APPLIED MARINE BIOLOGY AND OCEANOGRAPHY - Associate Degree

First Semester

ENG 111	English Composition	3
MAT 131	Algebra and Introduction to Statistics	3
CHM 111	General Chemistry	4
BIO 111	General Biology	4
OCO 111	Elements of Oceanography	4
		18

Second Semester

ENG 112	American Literature	3
PHY 111	Technical Physics I	4
MAT 132	Statistics	3
BIO 113	Invertebrate Zoology	4
OCO 112	Instrumentation and Methods in Oceanography	3
		17

Third Semester

ECO 201	Economics	3
PHY 112	Technical Physics II	4
NAV 21	Survey of Navigation	3
BIO 211	Microbiology	4
OCO 211	Chemical Oceanography	4
		18

Fourth Semester

SSC	Social Science Elective	3
BIO 212	Ecology	4
BIO 248	Fishery Science	4
OCO 212	Physical and Geological Oceanography	4
BIO 246	Marine Botany	4
		19

OCEANOGRAPHY/BIOLOGY OPTION - Associate Degree

First Semester

BIO 111	General Biology	3
ENG 111	English Composition	3
MAT 131	Algebra and Introduction to Statistics	3
MS 111	Engineering I	3
MS 113	Navigation I	2
MS 115	Marlinspike Seamanship I	1
OCO 111	Elements of Oceanography	3
SEA 111	Sea Time I (required)	0
		18

Second Semester

BIO 112	Marine Biology	3
MAT 132	Statistics	3
MS 112	Engineering II	3
MS 114	Navigation II	2
MS 116	Marlinspike Seamanship II	1
OCO 112	Instrumentation and Methods in Oceanography	3
SEA 112	Sea Time II (required)	0
		15

Third Semester

BIO 213	Invertebrate Zoology	3
ECO 201	Economics	3
BIO 214	Ecology	3
MTL 10	Metals Fabrication	2
OCO 210	Chemical Oceanography	3
PHY 111	Technical Physics I	4
SEA 213	Sea Time III (required)	0
		18

Fourth Semester

BIO 210	Microbiology	3
ENG 112	American Literature	3
BIO 245	Marine Botany	3
BIO 249	Fisheries Science	3
OCO 213	Physical and Geological Oceanography	3
SSC	Elective	3
SEA 212	Sea Time IV (required)	0
		18

ENGINEERING OPTION

First Semester

		DEG.	DIP.
MAT 111	College Algebra and Trigonometry	3	
MAT 11	Mathematics (Algebra)		2
MAT 13	Mathematics (Trigonometry)		2
OCO 111	Elements of Oceanography	3	3
MS 111	Engineering I	3	3
MS 113	Navigation I	2	2
MS 115	Marlinspike Seamanship I	1	1
SEA 111	Sea Time I	2	2
PED 20	Physical Education	1	1
		15	16

Second Semester

		DEG.	DIP.
ENG 111	English Composition	3	
ENG 11	Communications I		3
OCO 112	Instrumentation and Methods in Oceanography	3	3
MS 112	Engineering II	3	3
MS 114	Navigation II	2	2
MS 116	Marlinspike Seamanship II	1	1
SEA 112	Sea Time II	2	2
PHY 111	Physics	3	
MS 217	Engineering Ship's Maintenance I	1	1
		18	15

Third Semester

		DEG.	DIP.
ECO 201	Economics	3	
ENG 112	American Literature	3	
PHY 09	Physics for Marine Science		3
MS 211	Engineering III	8	8
MS 222	Engineering Ship's Maintenance II	1	1
SEA 213	Sea Time Engineering III	2	2
		17	14

Fourth Semester

		DEG.	DIP.
MTL 10	Metals Fabrication	2	2
SSC	Elective	3	
MS 212	Engineering IV	8	8
MSL 40	Lifeboat Training Program Elective	2	2
SEA 214	Sea Time Engineering IV	2	2
		17	14

Electives (If available)

		DEG.	DIP.
MS 14	Refrigeration and Air Conditioning	2	2
MSL	First Aid	1	1
MS 213	Deck Machinery	2	2

DECK OPTION - Associate Degree/Diploma

First Semester

MAT 111	College Algebra and Trigonometry	3	

		DEG.	DIP.
OCO 111	Elements of Oceanography	3	3
MS 111	Engineering I	3	3
MS 113	Navigation I	2	2
MS 115	Marlinspike Seamanship I	1	1
SEA 111	Sea Time I	2	2
MAT 11	Mathematics (Algebra)		2
MAT 13	Mathematics (Trigonometry)		2
PED 20	Physical Education	1	1
		15	16

Second Semester

		DEG.	DIP.
ENG 111	English Composition	3	
ENG 11	Communications I		3
OCO 112	Instrumentation and Methods in Oceanography	3	3
iS 112	Engineering II	3	3
MS 114	Navigation II	2	2
MS 116	Marlinspike Seamanship II	1	1
SEA 112	Sea Time II	2	2
PHY 111	Technical Physics	3	
		17	14

Third Semester

		DEG.	DIP.
MS 213	Deck Machinery	2	2
ECO 201	Economics	3	
ENG 112	American Literature	3	
MS 223	Deck Ship Maintenance	1	1
PHY 09	Physics for Marine Science		3
MS 221	Wire Splicing	1	1
MS 215	Navigation III	6	6
SEA 215	Sea Time III	2	2
MSL 67	Rules of the Road	2	2
		20	17

Fourth Semester

		DEG.	DIP.
MS 219	Electronic Navigation	2	2
SSC	Elective	3	
MS 216	Navigation IV	5	5
MSL 40	Lifeboat Training	2	2
MSL 68	Rules of the Nautical Road	2	2
SEA 216	Sea Time Deck IV	2	2
MS	Deck Safety Elective	1	1
		17	14

Electives (If available)

		DEG.	DIP.
MTL 10	Metal Fabrication	2	2
MSL	First Aid	1	1

The instructional staff for the courses listed above consists of the following:

Arlander, Richard P., M.S., First Assistant Engineer
Billings, Martin B., B.S., Chief Engineer
Davenport, David G., B.S., Second Assistant Engineer
Doughty, Aftin L., Chief Engineer
Eayrs, Weston III, B.S.
Finley, Peter, B.S., Third Assistant Engineer
Flahive, William F., Ph.D.
Goode, Robert E., M.S., Department Co-Chairman
Hall, Arthur D., Master
Hall, Charles M., B.S., Third Mate
Hathaway, Brian M., B.S., Master, Captain Training Vessel, Department Co-Chairman
Leonard, George E., B.S., Third Mate, Training Vessel
Manduca, Theodore, M.S., First Assistant Engineer
Page, John, B.S., Chief Mate
Siegel, I. Myra, M.S.
Siegel, Robert E., M.S.
Swanson, Carl F., B.S., Master

To obtain further information, address inquiries to:

Director of Admissions
Southern Maine Vocational Technical Institute
Fort Road
South Portland, Maine 04106

SOUTHWEST MISSOURI STATE UNIVERSITY
Springfield, Missouri 65802

The marine science program offered at Southwest Missouri State University is provided partly on the local campus, but principally in cooperation with the Gulf Coast Research Laboratory located at Ocean Springs, Mississippi 39564. A number of courses are offered on the Springfield campus and a number of specialized marine courses are provided at the Gulf Coast Research Laboratory. The Springfield facility is equipped with a 250 gallon marine aquarium, various research type equipment for analytical and physiological work and an electron microscope for studying ultrastructure. Gulf Coast Research Laboratory has nine buildings most of which have been rebuilt after Hurricane Camille demolished the old ones in August, 1969. In addition, 11 vessels are available from a 64-1/2-foot Gulf Researcher down to two 16-1/2-foot Boston Whalers. Research equipment, library facilities, electron microscopes are all available for doing advanced undergraduate and graduate research work. The Director of the Gulf Coast Research Laboratory is Dr. Harold D. Howse.

The B.A. or B.S. degree may be completed with an emphasis in Marine Biology.

The following courses are offered in conjunction with the above program:

UNDERGRADUATE COURSES

Biology 134	General Botany	5
Biology 167	General Zoology	5
Biology 168	Introduction to Marine Zoology	4
Biology 270	Invertebrate Zoology	4
Biology 369	General Ecology	4
Biology 399	Special Topics in Biology	1-5

GRADUATE COURSES

Biology 426	Estuarine and Marsh Ecology	6
Biology 427	Field Biology	1-3
Biology 441	Marine Botany	4
Biology 462	Marine Microbiology	5
Biology 475	Ichthyology	4
Biology 478	Marine Vertebrate Zoology	6

Biology 482	Marine Invertebrate Zoology	6
Biology 561	Parasites of Marine Animals	6

The instructional staff for the courses listed above consists of the following:

SOUTHWEST MISSOURI STATE UNIVERSITY

Kahler, George A., Jr., Ph.D., Assistant Professor
Redfearn, Paul L., Jr., Ph.D., Professor
Taber, Barbara A., M.A., Instructor
Topping, Milton S., Ph.D., Assistant Professor
Weber, Wallace R., Ph.D., Associate Professor

GULF COAST RESEARCH LABORATORY

Ballard, Buena S., Ph.D., Professor
Cake, Edwin W., Jr., Ph.D., Head, Oyster Biology Section
Channell, R.B., Ph.D., Professor
Cliburn, J. William, Ph.D., Professor
Cook, David W., Ph.D., Registrar and Head, Microbiology Section
Eleuterius, Lionel N., Ph.D., Head, Botany Section
Howse, Harold D., Ph.D., Director and Head, Microscopy Section
Overstreet, Robin, Ph.D., Head, Parasitology Section

To obtain further information, address inquiries to:

Dr. R.T. Stevenson, Head
Department of Life Sciences
Southwest Missouri State University
Springfield, Missouri 65802

SOUTHWEST TEXAS STATE UNIVERSITY
San Marcos, Texas 78666

Southwest Texas State University has a cooperate program in marine biology with Moody College of Marine Science, Texas A&M University, Galveston, Texas, and The University of Texas Marine Institute, Port Aransas, Texas.

A student completes all of his college work at Southwest Texas State University except 12 to 19 semester hours of marine biology which he takes at one or both of the aforementioned marine stations. While at Southwest Texas State University, students are closely associated with students pursuing an area of emphasis in aquatic biology and wildlife management.

This program makes accessible for student use the equipment and facilities at Moody College of Marine Science, Texas A&M University, Galveston, Texas, and The University of Texas Marine Institute, Port Aransas, Texas. Research equipment at the Aquatic Station, Southwest Texas State University includes a submarine photometer, seine nets, boats and motors, oxygen analyzers, conductivity meters, pH meters, spectrophotometers, microscopes, photographic equipment, climate control chamber, centrifuges, flow meters, AA spectrophotometer, and nutrient analysis equipment. Aquatic ecosystems include a holding house, raceways, 12 ponds, and a constant temperature river. Different type reservoirs are within a 20-minute drive from the Station. The University Library is across the street from the Station. Housing is available within walking distance from the Station.

The following degrees are offered by the Biology Department:

1. B.S. Major in Biology, Area of Emphasis in Marine Biology. (New Program)

a) Biology	22 credits
b) Marine Biology	9-12 credits
c) Chemistry	24 credits
d) Physics	8 credits
e) Mathematics	9 credits

Recipients in past academic year: 8.

2. M.S. in Biology. Thesis degree with courses and thesis in aquatic or marine biology. (New Program)

a) Thirty-six credits including three hours of seminar, six hours of thesis, and three hours of scientific methods.
b) A comprehensive oral examination.

Recipients in past academic year: 6.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Bio 3470	Invertebrate Zoology	4
Bio 1410	Botany	4
Bio 1420	Zoology	4
Bio 2360	Aquatic Biology	3
Bio 3360	Plant Taxonomy	3
Bio 3450	Genetics	4
Bio 4315	Ichthyology	3
Bio 4316	Ecology	3
Bio 4325	Biometrics	3
Bio 4365	Entomology	3
Bio 4370	Limnology	3
Bio 3322	Oceans and Estuaries	3

GRADUATE COURSES

Marine Biology courses offered at the above-mentioned marine stations.

Courses offered at Southwest Texas State University:

Bio 5316	Pollution Biology	3
Bio 5335	Fisheries Management	3
Bio 5336	Fish Parasitology	3
Bio 5316	Limnological Methods	3
Bio 5323	Wildlife Management	3
Bio 5321	Ornithology	3
Bio 5322	Mammalogy	3
Bio 5390	Topics in Ecology	3

The instructional staff for the courses listed above consists of the following:

Baccus, John, Ph.D., Assistant Professor
Hannan, H.H., Ph.D., Professor
Huffman, D.G., Ph.D., Assistant Professor
Longley, G.C., Ph.D., Assistant Professor
Sissom, Stanley, Ph.D., Associate Professor
Whiteside, B.G., Ph.D., Associate Professor
Young, W.C., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. Willard Young, Chairman
Biology Department
Southwest Texas State University
San Marcos, Texas 78666
(512) 245-2171

STANFORD UNIVERSITY
HOPKINS MARINE STATION
Pacific Grove, California 93950

The station occupies an exposed rocky headland, Mussel Point. The University holds title to about 11 acres on and around that point, which includes approximately one mile of shoreline. The intertidal and offshore waters surrounding the marine station are protected by law as a marine reserve and provide excellent resources for research and teaching in marine biology. The station operates as a branch of the Department of Biological Sciences of the University. The teaching and research facilities at the station are housed in three main buildings. The Agassiz Laboratory provides space and equipment for studies in the biology and ecology of marine invertebrates, fishes and algae. Special facilities include rooms equipped for microtechnique and photomicrography, a large aquarium room, a reference collection of marine invertebrates and the Gilbert M. Smith herbarium of marine algae. The two-story Jacques Loeb Laboratory provides rooms and other facilities for experimental studies on the development, physiology and biochemistry of marine animals, plants and microorganisms. Cold rooms, constant temperature rooms and a photographic darkroom are available. The laboratories are equipped with a wide variety of specialized equipment including a mass spectrometer, gas chromatography, recording spectrophotometers, radiation counting equipment, high-speed refrigerated centrifuges, a preparative ultra-centrifuge, neurophysiological equipment and facilities for electrophoresis and chromatography.

The Lawrence Blinks Laboratory houses two large laboratories, nine smaller research rooms, and five dark laboratories, some equipped for experimental temperature and light regimes. All laboratories are equipped with running seawater.

The Monterey Boatworks is an historic building that for years was the site of a thriving boatworks operation. In 1977 it was entirely rebuilt and now houses the Walter K. Fisher Lecture Hall, the C.B. van Niel Library and a suite of lockers and showers for scuba divers. The library contains a constantly expanding collection of books in the fields most under study (algology, invertebrate zoology, development, ecology, physiology, biochemistry, microbiology, and biological oceanography). About 450 serial publications in these fields are received. The collection currently consists of some 15,000 volumes.

Students can work toward the Ph.D. or M.S. degrees, with specialization in algology, invertebrate zoology, cellular and developmental biology, immunology, neurobiology, comparative physiology, behavior, population biology, and ecology.

In addition, the Station provides courses in marine biology designed for matriculated and nonmatriculated undergraduates and graduates in biology during each quarter.

The following courses are offered in conjunction with the above programs:

30H	Marine Biology	4
100H	Marine Algae	6
105H	Subtidal Communities	6
111H	Marine Invertebrates	6
112H	Marine Invertebrates	6
113H	Introduction to Oceanic Biology	6
123H	Invertebrate Biology	5
125H	Developmental Biology	6
126H	Experimental Analysis of Embryonic Development	5
130H	Biological Clocks	5
140H	Chemical Ecology	3
160H	Problems in Subtidal Communities	6
165H	Experimental Neurobiology	6
166H	Comparative Neurobiology	5
175	Problems in Marine Biology	15
199H	Special Problems	Arranged
283H	Bioactive Marine Natural Products	1
284H	Marine Pharmacology	1
300H	Graduate Research	Arranged

The resident instructional staff for the courses listed above consists of the following:

Abbott, Donald P., Ph.D., Professor of Biology and Associate Director, Hopkins Marine Station
Abbott, Isabella A., Ph.D., Professor of Biology
Baxter, Charles H., M.A., Senior Lecturer in Biology
Burnett, Robin D., Ph.D., Lecturer in Biology
Epel, David, Ph.D., Professor of Biology
Fuhrman, Frederick A., Ph.D., Professor of Physiology
Pittendrigh, Colin S., Ph.D., Professor of Biology and Director, Hopkins Marine Station
Thompson, Stuart, Ph.D., Assistant Professor of Biology

To obtain further information, address inquiries to:

Hopkins Marine Station
Pacific Grove, California 93950

STATE UNIVERSITY OF NEW YORK AT STONY BROOK
Long Island, New York 11794

The Marine Sciences Research Center (MSRC) is the center for research, graduate education, and public service in the marine sciences for the State University of New York system. It offers the only SUNY graduate degree programs in oceanography and marine environmental sciences. MSRC has programs of research in biological, chemical, geological, and physical oceanography; in coastal zone management, and in fishery management. MSRC scientists have a strong commitment to translate the results of research into forms readily usable for management, and when possible, solution of environmental problems. Emphasis in the research and educational programs is on the coastal ocean, approximately to the seaward edge of the continental shelf.

MSRC is located on the South Campus of the State University of New York at Stony Brook. The Center is ideally situated for studies of a variety of coastal environments including estuaries, lagoons, salt marshes, barrier islands, and continental shelf waters. The proximity of New York City and the burgeoning populations of Long Island and Connecticut make New York coastal waters an excellent laboratory for evaluating conventional methods of pollution abatement and coastal zone management. They also present an exciting and demanding challenge to the most imaginative and innovative scientists and planners to develop more effective ways of accommodating the manifold uses of these valuable natural resources.

Since oceanography depends heavily upon its parent sciences, and since an undergraduate degree does not qualify the holder at a professional level, graduate students in oceanography, while concentrating on the special problems posed for scientists who work at sea, must, in addition, progress to professional competence within physics, chemistry, biology, geology, or engineering. This means close association with the practitioners of those disciplines; the kind made possible by the presence of strong graduate programs in those fields. A graduate program in oceanography of superior excellence is difficult, if not impossible, to maintain in the absence of equally strong graduate programs in the basic parent sciences.

At Stony Brook students at the Marine Sciences Research Center are fortunate. Strong programs in physics, chemistry, biology, and geology as well as in pure mathematics, applied mathematics, and engineering exist on campus. Not only do they exist; they are open to oceanographers who want to increase their professional competence. Opportunities for learning and for collaborative research in these disciplines are unlimited.

The main laboratories and offices of the Marine Sciences Research Center (MSRC) are housed in a cluster of buildings with more than 4,500 square meters of usable floor space. Laboratories are well-equipped for most analyses, and students and faculty have access, with special arrangements, to equipment and facilities elsewhere on the main campus and at nearby Brookhaven National Laboratory and Cold Spring Habor Laboratory. Center and University Computing facilities are excellent. The University Library has extensive holdings in oceanography and environmental sciences as well as in the basic sciences.

MSRC owns and manages Flax Pond jointly with the New York State Department of Environmental Conservation. An 0.6 square kilometer salt marsh located approximately seven kilometers from campus, Flax Pond is surrounded by large estates and has retained a relatively pristine character. Approximately three-fourths of the marsh has been set aside for research and education, and competing activities are prohibited. The MSRC maintains a well-equipped laboratory with a continuous seawater system at the Pond.

The Center operates an 18-meter research vessel, the R/V Onrust, which was completed late in 1974. The R/V Onrust, designed specifically for oceanographic research, is one of the finest vessels of her kind. She is outfitted for virtually every kind of oceanographic sampling. MSRC also maintains a number of smaller boats.

The following degrees are offered:

1. M.S. in Marine Environmental Sciences. The program has the traditional tracks in biological, chemical, geological, and physical oceanography, and a special track designed to prepare students for careers in environmental management. The emphasis is on coastal and shelf processes. Formal instruction consists of a thoroughly interdisciplinary, problem-oriented curriculum. Students also must take courses selected from other departments on campus.

Requirements for a degree include successful completion with a "B" average of an approved course of study totaling 30 credits, of which not more than six may be MAR 580 seminar and/or MAR 590 research. Students are required to take MAR 501, 502, 503, 504, and 506; and to write a thesis of publishable quality.

In addition to full-time admission, the program offers part-time training to professionals who wish to improve or broaden their skills, or redirect their careers. Required courses are alternated yearly between the day and evening schools, and are arranged so that during any given year, half of the required core courses are given in the evening.

The Department of Earth and Space Sciences and the Marine Sciences Research Center jointly sponsor a special five-year B.S./M.S. program for outstanding students who wish to pursue a specialty in geological oceanography. The Center has a similar five-year program with the College of Engineering and Applied Sciences for outstanding Engineering Science majors who wish to pursue a specialty in ocean engineering and coastal oceanography.

Fourteen students received the M.S. degree in Marine Environmental Studies in 1978-1979.

2. Ph.D. in Coastal Oceanography. The doctoral program in coastal oceanography is a new program designed to give students professional command of oceanography at the highest level and to provide them with the means to develop their capacity for creative research. It prepares students to formulate and attack coastal oceanographic problems -- biological, chemical, geological, and physical -- practically and theoretically. It builds on a flexible, interdisciplinary program and offers students the opportunity to extend their command of the tools of scholarship and to mature their judgment so that

they may become independent, effective solvers of problems.

Every student is required to complete successfully, or to demonstrate proficiency in, core courses in biological, chemical, geological, and physical oceanography. Advanced courses offered by the MSRC are required as are courses in related disciplines offered by other departments on campus.

Normally the master's degree, which requires the preparation of an essay of publishable quality, is required of all candidates for the doctor's degree. A doctoral dissertation is required of all candidates. It must demonstrate the ability to formulate an important original problem and to deal with it effectively to increase the student's understanding of oceanography and enrich the scientists whose peer he or she aspires to be.

The entire program is flexible and well suited to the mature student whose professional goals are clearly formulated. It also provides, in its earlier stages, for extensive exploration of opportunities in the field. Students are free to emphasize their own interests, whether they be in the biological, chemical, geological, physical, or management aspects of the coastal ocean, but they will also acquire a broad understanding of the processes that characterize the coastal ocean. Productive work in coastal oceanography requires a general understanding of the disciplines and a profound knowledge of at least one basic science.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

DEPARTMENT OF EARTH AND SPACE SCIENCES

ESS 102	The Earth	3
ESS 104	Oceanography	3
ESS 106	The Ages before Man	3
ESS 114	Oceanography Seminar	1
ESS 202	Environmental Geology	3
ESS 211	Paleontology	4
ESS 325	Marine Geochemistry	3
ESS 326	Chemical Sedimentology	3
ESS 331	X-ray Diffraction Techniques	3
ESS 351	Geophysics I	3
ESS 352	Geophysics II	3
ESS 353	Marine Ecology	3
ESS 363	Sedimentation and Sedimentary Rocks	4
ESS 364	Marine Geochemistry	3

DIVISION OF BIOLOGICAL SCIENCES

BIO 241	Life in Water	4
BIO 306	Oceanography for Biologists	1
BIO 343	Invertebrate Zoology	4
BIO 351	Ecology	3
BIO 352	Ecology Laboratory	2
BIO 353	Marine Ecology	3
BIO 356	Marine Ecology Laboratory	2
BIO 381	Marine Vertebrate Zoology	2
BIO 440	Advanced Invertebrate Zoology	2

COLLEGE OF ENGINEERING AND APPLIED SCIENCES

ESI 280	Introduction to Ocean Engineering	3
ESM 305	Materials for Ocean Engineering	3
ESC 345	Theoretical Meteorology	3
ESC 346	Experimental Meteorology	3
ESC 361	Vehicular Dynamics	3
ESC 364	Introduction to Fluid Dynamics	4
ESC 390	Physical Oceanography	3

GRADUATE COURSES

MARINE SCIENCES RESEARCH CENTER

MAR 501	Descriptive Physical Oceanography	3
MAR 502	Biological Oceanography	4
MAR 503	Chemical Oceanography	4
MAR 504	Dynamical Oceanography	3
MAR 506	Geological Oceanography	3
MAR 521	General Problems of the Marine Environment	3
MAR 522	Case Studies in Environmental Problems	3
MAR 523	Marine Botany	4
MAR 530	Scientists in Organizations	3
MAR 531	Regional Planning Applied to Marine Sciences	3
MAR 550	Topics in Marine Science	Variable
MAR 553	Fishery Management	3
MAR 580	Seminar	1
MAR 590	Research	Variable
OCN 601	Planktonic Herbivory - An Experimental Approach	3
OCN 602	The Marine Nitrogen Cycle	3
OCN 603	Concepts and Practices in the Management of Shellfish Resources	3
OCN 604	Diffusion in Aquatic Environments	3
OCN 605	Acoustic Techniques in Coastal Marine Geology	3
OCN 606	Design of Field Experiments	3
OCN 607	Physics of Sedimentary Processes	3
OCN 608	Estuarine Geochemistry	3
OCN 609	Estuarine Oceanography	3
OCN 610	Waves and Tides	3
OCN 650	Research	Variable
OCN 651	Special Topics	Variable
CEB 575	Introduction to Oceanography	3
CEB 576	The Marine Environment of Long Island	6
CEB 578	Long Island Coastal Environment	1-3

DEPARTMENT OF EARTH AND SPACE SCIENCES

ESS 510	Global Geology	3
ESS 511	Advanced Paleontology	3
ESS 514	Advanced Stratigraphy	
ESS 515	Seminar in Detrital Sedimentation	3
ESS 516	Paleoecology	3
ESS 518	Carbonate Sediments	4
ESS 525	Marine Geochemistry	3
ESS 526	Principles of Chemical Sedimentology	3
ESS 550	Global Tectonics	3

DIVISION OF BIOLOGICAL SCIENCES

CEB 500	Natural History of Intertidal Organisms	3
BEE 550	Principles of Ecology	4
BEE 552	Biometry	4
BEE 689	Seminar on Adaption of Marine Organisms	2

COLLEGE OF ENGINEERING AND APPLIED SCIENCES

ESC 504	Environmental Pollution	3

ESC 505	Principles of Water Pollution	3
ESC 506	Water Quality Laboratory	3
ESC 509	Advanced Fluid Mechanics I, Perfect Fluids	3
ESC 512	Advanced Fluid Mechanics II, Viscous Fluids	3
ESC 517/518	Wastewater Collection and Treatment Systems I and II	3, 3
ESC 529	Vehicular Dynamics	3
ESC 537	Experimental Fluid Mechanics	3
ESC 545/546	Theoretical Meteorology	3, 3
ESM 613	Seminar on Materials and Environment	3

The instructional staff for the courses listed above consists of the following:

MARINE SCIENCES RESEARCH CENTER

Baylor, Edward R., Ph.D., Professor of Biological Oceanography
Bokuniewicz, Henry J., Ph.D., Assistant Professor of Geological Oceanography
Bowman, Malcolm J., Ph.D., Associate Professor of Physical Oceanography
Brinkhuis, Boudewijn H., Ph.D., Assistant Research Professor of Biological Oceanography
Capone, Douglas C., Ph.D., Assistant Research Professor of Biological Oceanography
Carpenter, Edward J., Ph.D., Associate Professor of Biological Oceanography
Carter, Harry H., M.S., Professor of Physical Oceanography
Dayal, Ramesh, Ph.D., Assistant Research Professor of Chemical Oceanography
Duedall, Iver W., Ph.D., Associate Professor of Chemical Oceanography
Essias, Wayne E., Ph.D., Research Assistant Professor of Biological Oceanography
Kinsman, Blair, Ph.D., Professor of Physical Oceanography
Koppleman, Lee E., DPA, Professor, Part-time, Coastal Zone Planning and Management
Like, Irving, J.D., Professor, Part-time, Environmental Law
Malouf, Robert E., Ph.D., Assistant Professor of Shellfish Biology
McHugh, J.L., Ph.D., Professor of Marine Resources
O'Connors, Harold B., Ph.D., Assistant Professor of Biological Oceanography
Okubo, Akira, Ph.D., Professor of Physical Oceanography
Pritchard, Donald, Ph.D., Professor of Physical Oceanography
Schubel, J.R., Ph.D., Professor of Geological Oceanography
Scranton, Mary I., Ph.D., Assistant Professor of Chemical Oceanography
Squires, Donald F., Ph.D., Professor of Marine Affairs
Terry, Orville W., Ph.D., Associate Research Professor of Biological Oceanography
Weyl, Peter K., Ph.D., Professor of Physical Oceanography
Wilson, Robert E., Ph.D., Assistant Professor of Physical Oceanography
Woodhead, Peter M.J., M.S., Research Professor of Biological Oceanography
Wurster, Charles F., Ph.D., Associate Professor of Environmental Sciences

DEPARTMENT OF EARTH AND SPACE SCIENCES

Bence, A. Edward, Professor of Petrology
Bretsky, Peter W., Professor of Paleoecology
Hanson, Gilbert N., Professor of Petrology
Meyers, William J., Associate Professor of Sedimentology
Reeder, Richard, Assistant Professor of Geochemistry
Schaeffer, Oliver A., Professor of Geochemistry
Smoot, Joseph P., Assistant Professor of Sedimentology

DIVISION OF BIOLOGICAL SCIENCES

Hechtel, George T., Ph.D., Associate Professor of Ecology and Evolution
Koehn, R.K., Ph.D., Associate Professor of Ecology and Evolution
Levinton, Jeffrey A., Ph.D., Associate Professor of Ecology and Evolution
Slobodkin, Lawrence B., Ph.D., Professor of Ecology and Evolution
Williams, George C., Ph.D., Professor of Ecology and Evolution

ENGINEERING AND APPLIED SCIENCES

Bilello, John C., Dean of Engineering and Applied Sciences, Professor of Materials Science
Bradfield, Walter S., Professor of Mechanical Engineering
Carleton, Herbert R., Professor of Materials Science and Electrical Engineering
Chevray, Rene, Associate Professor of Mechanical Engineering
Herman, Herbert, Professor of Materials Science
O'Brien, Edward E., Professor of Mechanical Engineering
Wang, Franklin F.Y., Professor of Materials Science

To obtain further information, address inquiries to:

Dr. J.R. Schubel, Director
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11794
(516) 246-7710

STATE UNIVERSITY OF NEW YORK
AGRICULTURAL AND TECHNICAL COLLEGE
Farmingdale, New York 11735

The two-year Biological Technology curriculum at State University of New York, at Farmingdale, offers a second year specialization in the training of technicians in the marine-environmental field. The degree earned is the Associate in Applied Science (A.A.S.) in Biological Technology.

The teaching facilities consist of seven well-equipped laboratories -- one specially containing modern equipment to teach marine science, as well as the latest environmental testing techniques. Additional facilities include a large walk-in cold room, and a modified van which serves as a mobile environmental laboratory, together with a boat for on-site estuarine studies. The College has access to several larger vessels from neighboring institutions (Maritime, Stonybrook, etc.) for instruction and work in deeper offshore areas.

Requirements for graduation are the successful completion of 65 credits, including nine in Social Science, six in English, six in Math, and 12 in Chemistry.

The following biologically oriented undergraduate courses are offered in conjunction with this program:

First Year

BI 193	Zoology	4
BI 192	Botany	4
BI -	Comparative Vertebrate Anatomy	4
BI 108	Entomology	3

Second Year

BI 104	General Microbiology	3
BI 223	Principles of Ecology	3
BI 234	Marine Botany	3
BI 236	Marine Zooology	3
BI 221	Coastal Processes	3
BI 203	Bioinstrumentation	3
BI 253	Environmental Problems	3

The instructional staff for the above courses consists of the following:

Alcamo, Edward, Ph.D., Professor
Elgart, Robert, Ph.D., Professor
Erlanger, Charles, M.S., Professor
Smiles, Michael, M.S., Assistant Professor

To obtain further information, address inquiries to:

Dr. Robert Elgart, Chairman
Department of Biological Sciences
State University, Agricultural and Technical College
Farmingdale, New York 11735

STATE UNIVERSITY OF NEW YORK
COLLEGE OF ARTS AND SCIENCE
Oswego, New York 13126

The State University College at Oswego is located on the shores of Lake Ontario. A number of laboratories are used for oceanographic and limnologic research and teaching. Some of the equipment available includes, atomic absorption spectrophotometer, gas-liquid chromatography, salinity-conductivity meter, dissolved oxygen meters, photometer, mapping equipment, sieve and rapid sediment analysis equipment, baththermograph, semi-dip-gill and trap nets, specific ion probe, microscopes, spectrophotometers, and various grabs and coring devices.

Some of the equipment and facilities are provided by the State University Research Center at Oswego (SURCO) and Rice Creek Biological Field Station. Two Boston Whalers and several smaller boats are available for research in Lake Ontario near shore waters and lagoons.

A field course is offered twice a year at the Discovery Bay Laboratory of the University of West Indies in Jamaica. This is primarily a biology course dealing with the ecology of the coral reef and near shore tropical environments.

A Marine Sciences Minor is offered by completing 19 hours in approved courses plus six hours of math, eight hours of chemistry, and eight hours of physics. It is expected that most students will major in Biology, Chemistry, Geology, Meteorology, or Zoology.

The following degrees are offered:

1. B.A. in Biology. Thirty hours in biology; twenty four hours in chemistry, math and physics. Degrees granted in 1979 - 50.

2. B.A. in Chemistry. Thirty-two to thirty-three hours in chemistry; 20 hours in math and physics. Degrees granted in 1979 - 4.

3. B.S. in Chemistry. Forty-four hours in chemistry; 29 hours in math, physics, and foreign language. Degrees granted in 1979 - 23.

4. B.A. in Geology. Thirty-three hours in geology; 32 hours in chemistry, math, and physics. Degrees granted in 1979 - 6.

5. B.A. in Meteorology. Twenty-four hours in meteorology, nine hours in earth science, 31 hours in chemistry, math, and physics. Degrees granted in 1979 - 0.

6. B.S. in Meteorology. Twenty-seven hours in meteorology; six hours in earth science, 37 hours in chemistry, math, and physics. Degrees granted in 1979 - 15.

7. B.A. in Zoology. Thirty-one hours in zoology; 29-30 hours in chemistry, math and physics. Degrees granted in 1979 - 30.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

DEPARTMENT OF BIOLOGY

Biol. 111-112	Foundations of Biology	8
Biol. 192-292	Problems in Biology	6
Biol. 392-492	Problems in Biology	6
Biol. 215	Genetics	3
Biol. 240	The Plant Kingdom	3
Biol. 270	The Animal Kingdom	3
Biol. 301	Topics in Modern Biology	3
Biol. 310	Microbiology	3
Biol. 320	Introductory Ecology	3
Biol. 362	Tropical Botany	3
Biol. 377	Biology of Marine Organisms	3
Biol. 399	Independent Study	3

DEPARTMENT OF CHEMISTRY

Chem. 111-212	General Chemistry	8
Chem. 322	Analytical Chemistry	4
Chem. 331, 332, 334L	Organic Chemistry	9
Chem. 341, 341L, 342, 342L	Physical Chemistry	8
Chem. 399	Independent Study	3
Chem. 425	Instrumental Analysis	4
Chem. 461	Biochemistry	3

DEPARTMENT OF EARTH SCIENCES

Geology

Geol. 100, 100L	Introductory Geology	4
Geol. 200, 200L	Historical Geology	4
Geol. 310	Mineralogy	4
Geol. 320	Sedimentation	3
Geol. 330	Structural Geology	3
Geol. 336	Continental Drift	3
Geol. 390	Special Topics	3
Geol. 399	Independent Study	3
Geol. 416	Petrology	3
Geol. 420	Stratigraphy	3
Geol. 440	Paleontology	3
Geol. 492	Lake Ontario Environments	3

Meteorology

Met. 100	Introductory Meteorology	3
Met. 301, 302	Synoptic Meteorology	6
Met. 305	Climatology	3
Met. 335	Micrometeorology	3
Met. 390	Special Topics	3
Met. 401	Atmospheric Physics	3
Met. 411, 412	Dynamic Meteorology	6
Met. 498	Seminar	3

Oceanography

Oc. 100, 100L	Introductory Oceanography	4
Oc. 300	Coastal Environments	3
Oc. 350	Physical Oceanography	3
Oc. 390	Special Topics	3
Oc. 399	Independent Study	3
Oc. 400	Geological Oceanography	3

DEPARTMENT OF ZOOLOGY

Zool. 110	Heredity and Reproduction	4
Zool. 120	Animal Function and Adaptation	4
Zool. 313	Field Natural History	3
Zool. 330	Introduction to Invertebrates	4
Zool. 340	Introduction to Vertebrates	4
Zool. 370	Comparative Anatomy	4
Zool. 376	Ornithology	3
Zool. 387	Field Zoology	3
Zool. 389	Animal Ecology	3
Zool. 392	Tropical Zoology	3
Zool. 399	Independent Study	3
Zool. 405	Limnology	3
Zool. 440	Ichthyology	3

The instructional staff for courses in the Marine Sciences are:

BIOLOGY

Markowitz, Mel, Ph.D., Assistant Professor
Nappi, Anthony J., Ph.D., Professor

CHEMISTRY

O'Donnell, Raymond, Ph.D., Associate Professor

EARTH SCIENCES

Chermack, Eugene, Ph.D., Associate Professor
Del Prete, Anthony, Ph.D., Associate Professor
Thomas, David J., Ph.D., Assistant Professor

ZOOLOGY

Engel, Ronald, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. Anthony Del Prete, Chairman
Department of Earth Sciences
State University of New York
Oswego, New York 13126

STATE UNIVERSITY OF NEW YORK
COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY
Syracuse, New York 13210

The College operates a multiple campus system with regional campuses and field stations located at Syracuse, Tully, Wanakena, Warrensburg, Cranberry Lake, Newcomb and Clayton. This system is composed of about one million square feet of facilities in 179 buildings and 25,000 acres of land.

The main campus is in Syracuse, and lies on 12 acres adjacent to Syracuse University, in an area that traditionally has been known as "The Hill." Specialized facilities at the Syracuse campus include electron microscopes, plant growth chambers, air-conditioned greenhouses, an animal environmental simulating chamber, a bio-acoustical laboratory, a 1000-curie cobalt-60 radiation source, radioisotope laboratory, computer center, and specialized instrumentation including nuclear magnetic resonance spectrometer, electron spin resonance spectrometer, mass spectrometer, ultracentrifuge, x-ray and infrared spectrophotometer. Photogrammatic and geodetic facilities of the forest engineering department include one of the most extensive arrays of equipment in the United States, with a Nistri TA-3 stereocomparator, Mann comparator, computerized Nistri photocartography, and nine other varieties of plotters. Extensive collections are available for study, including wood samples from all over the world, botanical materials, insects, birds, mammals and fishes.

The Cranberry Lake Campus, accessible only by water, is the site of the College's biological station, where, every year, a cooperative program in environmental biology is sponsored jointly by the College and other institutions of higher education. Bounded by 150,000 acres of forest preserve, by

Cranberry Lake, and by isolated forest bogs and beaver meadows, the extensive facilities are intensely utilized in a comprehensive curriculum of upper-level and graduate courses.

The Ellis International Laboratory, a magnificent island, is situated in the heart of the Thousand Islands-St. Lawrence River area off the village of Clayton. Accessible only by water, this laboratory, which is the College's most recent property acquisition, is an unusually appropriate site for the College-wide, cooperative and international environmental monitoring and research activities.

The College maintains a fleet of approximately 60 canoes and 25 registered outboard motor boats ranging from three hp. to 90 hp., located at various campus sites.

The Graduate Program in Environmental Science is a trans-disciplinary graduate program devoted to environmental science in most of its major fields of specialization. Programs are mounted in freshwater ecology, hydraulics, stream regimes, meteorological and climatic impacts on water systems, limnology, wetland ecology, as examples.

Student programs are devised by a faculty committee consisting of experts in the various fields of emphasis desired by the students. Students may enter the program from backgrounds in Law, Political Science, Marine and Environmental Chemistry, the various sciences, or the humanities. An integral part of the program is intensive research on issues confronting government and industry.

The College maintains the Ellis International Laboratory on a College-owned island in the middle of the Thousand Island region of the St. Lawrence River. This campus is devoted to research and education relating to the Great Lakes system. Equipment adequate for most studies is available -- including boats, sampling devices, and laboratory analytical tools.

Both the Master of Science and Doctor of Philosophy degrees are offered in this program.

To obtain further information, address inquiries to:

Professor Robert D. Hennigan
Graduate Program in Environmental Science
SUNY College of Environmental Science and
Forestry
Syracuse, New York 13210

STATE UNIVERSITY OF NEW YORK
THE MARITIME COLLEGE

Fort Schuyler, Bronx, New York 10465

The Maritime College is a specialized College of the State University of New York located on the Throgs Neck peninsula in the Bronx at the junction of the East River and Long Island Sound. Programs related to the merchant marine and the marine industry are offered. Excellent laboratory facilities for the undergraduate program are on campus. The College also operates the 533-foot, 17,630 ton Training Ship Empire State.

Degrees offered:

1. Bachelor of Science:

a) In Marine Transportation	49
b) In Meteorology and Oceanography	22

2. Bachelor of Engineering:

a) In Electrical Engineering	8
b) In Marine Engineering	43
c) In Naval Architecture	8
d) In Ocean Engineering	7

3. Master of Science:

a) In (Marine) Transportation Management	20

In addition to their degree, students receive preparation for license by the U.S. Coast Guard as Third Officer, either Mate or Assistant Engineer according to the curriculum. U.S. citizens also can qualify for a commission in the Merchant Marine Reserve (inactive) of the U.S. Navy.

MARINE TRANSPORTATION (BS) PROGRAM

The students who successfully complete the courses offered in the marine transportation program recieve the degree of Bachelor of Science and, after passing the required U.S. Coast Guard examination, a federal license as third mate in the merchant marine. Registered as a general-purpose degree, the B.S. degree in marine transportation satisfies all the requirements of the Court of Appeals for admission to law schools in New York state.

The marine transportation curriculum provides a choice of transportation economics or transportation management. These consist of courses in nautical science, marine navigation, ocean transportation, maritime law, accounting, management, statistics and economics principles, geography, and international trade and labor. Theory and practice are integrated by relating the efforts of the academic year ashore to those of the Summer Sea Term (SST) aboard the college training ship during the summer.

The Summer Sea Term is made up of two sessions, each approximately six weeks long. Every third (sophomore) and second (junior) classman is required to take one of the two sessions each summer. The first (senior) classmen are required to take both sessions of the SST. The summer voyages are required, credit-bearing, staff-supervised educational periods intended to insure necessary operational experience for all cadets. The term begins about June 1 and ends about September 1.

The objectives of the SST are accomplished by on-the-job training, by actual watch standing and ship work, and instruction through formal class periods which are designed to enhance the professional knowledge of the students.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Law	403-404	Maritime Law	2, 2
MT	201	Marine Cargo Operations	3
MT	202	Ocean Transportation	3
MT	402	Transportation Insurance	3
Met	311	Meteorology for Mariners	3
Naut	101-206-306	Ship Operations I and II and III	3, 3, 3
Naut	304	Rules of the Nautical Road	3
Naut	408	License Seminar	2
Nav.	205	Terrestial Navigation	3
Nav.	301	Nautical Astronomy and Celestial Navigation	3
Nav.	311	Meteorology for Mariners	3
Nav.	312	Electronic Navigation Systems	3
Nav.	402	Advanced Navigation	2

TRANSPORTATION MANAGEMENT (MS) PROGRAM

In its master of science program, the Department of Marine Transportation of the Maritime College provides graduate-level education in the field of transportation management by: developing in the student a pattern of original and creative thought; developing skill in analyzing and solving problems, and identifying the vital issues confronting the maritime industry.

The program will be for part-time, primarily evening students. The general requirements for the degree are as follows: a minimum of 33 credits of appropriate graduate study; a minimum cumulative average of 3.0 in all courses accepted toward the degree; residence equivalent to one year (completion of 24 credits of part-time study); research and thesis, and passing a comprehensive examination.

The following courses are offered in conjunction with the above program:

CORE

1501	Intensive Accounting	3
2301	Business Management	3
2407	Marketing	3
2501	Economic Analysis	3
2505	Managerial Finance	3
3502	Managerial Statistics I	3
4501	Intensive Survey of Business Law	3

SPECIALIZATION

2504	Industrial Relations in Transportation	3
3503	Managerial Statistics II	3
3506	Management of International Trade	3
3507	Introduction to Systems Analysis and Operations Research	3
2507	Economics of International Trade	3
3501	Analysis of Integrated Ocean Transporation and Ports or	
3508	Analysis of Air Transportation and Airports	3
3601	Thesis Seminar I	1
3602	Thesis Seminar II	2

ELECTIVES

1502	Cost Accounting for Management	3
1503	Transportation Managerial Accounting	3
2409	Financial Markets and Institutions	3
2502	Transportation Geography	3
2503	Latin American Business	3
2506	Managerial Economics	3
2508	The International Monetary System	
3504	Ocean Marine Cargo Insurance	3
3505	Ocean Marine Insurance Loss Adjusting	3
3509	Advanced Chartering Problems I	3
3510	Tanker Management and Operation	3
3512	Intensive Survey of Maritime Regulatory Law	3
3513	Comparative Transportation Systems	3
3514	Behavioral Science	3
3515	Intensive Survey of Air Transportation Regulatory Law	3
3516	Air Transport Equipment Management and Insurance	3
3517	Ocean Marine Hull and Protection and Indemnity Insurance	3
3518	Physical Distribution Management	3
3519	Analysis of Urban Transportation	3
3520	Advanced Chartering Problems II	3
3603	Seminar in Transportation Management Problems	3
3604	Seminar in Advanced Material Handling	3
4502	Intensive Survey of Admiralty Law	3
5501	Basic Data Processing Systems	3

The instructional staff for the courses listed above includes the following:

MARINE TRANSPORTATION DEPARTMENT

Brannigan, R.L., J.D., Assistant Professor of Law
Dooley, A.L., Ph.D., Associate Professor and Chairman of Marine Transportation
Dutcher, L.A., M.B.A., Master Mariner, Professor of Transportation
Georgiopoulos, C.P., J.D., Second Mate, Assistant Professor of Law
Hammon, A., M.B.A., Assistant Professor of Marine Transportation
Hart, J.C., J.D., Lecturer in Maritime Law
Leschziner, H.F., Electronics Technical Specialist
Ostman, H.E., M.B.A., Assistant Professor of Economics
Parnham, R.S., M.A., Master Mariner, Associate Professor of Marine Transportation
Paulus, R.S., B.S., Third Mate, Instructor of Marine Transportation
Pellicciaro, R.P., Ph.D., Associate Professor of Economics
Ragonese, F.E., M.B.A., Master Mariner, Assistant Professor of Marine Transportation
Sembler, W.H., M.B.A., Master Mariner, Professor of Marine Transportation
Smukler, P.R., M.A., Assistant Professor of Economics
Wills, L.A., M.S., Assistant Professor of Business Administration
Yahalom, S., M.A., Assistant Professor of Economics

To obtain further information, address inquiries to:

Professor Austin L. Dooley, Chairman
Department of Marine Transportation
S.U.N.Y. Maritime College
Fort Schuyler, Bronx, New York 10465

ENGINEERING (BE) PROGRAMS

The Engineering Department is located in the Science and Engineering Building. The department offers the following four curricula, each of which earns a Bachelor of Engineering degree: marine engineering, electrical engineering, naval architecture, and ocean engineering.

All are registered for professional engineering purposes by the New York State Department of Education's State Board of Engineering and Land Surveying. This permits senior engineering students to sit before graduation for the first two parts of the three-part national professional engineer license examination.

The engineering student takes a common core of pre-engineering subjects for the first two years at the College. During the spring term of the sophomore year, the student elects to concentrate.

Facilities available include: the analog computer laboratory, equipped with fully-expanded Electronics Associates Inc. computers, one 580 and three TR 20s, each with X-Y plotter, digital voltmeter and associate equipment; the Electrical Circuits, Machinery and Electronics Laboratory; the Transport Processes Laboratory, a thermal, heat transfer and fluid mechanics facility with supersonic and subsonic equipment; the Mechanical-Marine Engineering Laboratory, with an instrumented turbine power plant, diesel and gasoline engines, gas turbine, fuel cell, air conditioning and refrigeration, and air compressor; the Systems and Controls Laboratory, with an Autodynamics, Inc. model 500 control systems trainer as well as five test stations; the Manufacture Processes Laboratory has lathes, milling machines, shapers, drill presses, welding booth facilities, metalizing and heat-treating equipment; the Strength of Materials Laboratory has extensive testing equipment, including a 200,000-pound universal testing machine, three 60,000-pound universal testing machines, two 10,000-pound torsion machines, a Warner-Swasey vibration fatigue machine, and an elevated temperature tension testing machine.

The afloat engineering laboratory is in the engineering spaces of the College training vessel that is berthed during the academic year alongside the College's 600-foot pier. The ship's propulsion power plant is instrumented with equipment including a shaft torsionmeter, laboratory-type pressure and temperature sensing devices, and flowmeters that measure stream, water, gases, fuel oil and air.

The following courses are offered in the Ocean Engineering Department in conjunction with the above programs:

ELECTRICAL ENGINEERING

E 381	Electrical Engineering I	4
E 383	Network Analysis I	4
E 384	Electromagnetic Field I (Statics)	3
E 391	Electrical Engineering II	4
E 393	Networks Analysis II	3
E 491	Communications Theory	3
E 492	Switching Circuits	4
E 495	Electrical Machinery	4
E 496	Electron Devices	4

MARINE ENGINEERING

E 141	Orientation	3
E 241	Solid Mechanics I	4
E 251	Solid Mechanics II	3
E 251L	Solid Mechanics Laboratory	1
E 252	Transport Processes I	4
E 342	Transport Processes II	4
E 343	Engineering Analysis I	3
E 352	Transport Processes III	4
E 353	Engineering Analysis II	3
E 412	Ocean Engineering	4
E 441	Design I	4
E 442	Engineering Economics	2
E 451	Design II	4
E 452	Controls	3
E 453	Nuclear and Modern Concepts	2
E 454	Vibrations (Optional Offering)	3
E 454L	Vibrations Laboratory (Optional Offering)	1
E 459	Gas Dynamics (Optional Offering)	3

NAVAL ARCHITECTURE

NA 301	Ship Construction and Stability (for non-engineers)	3
E 361	Naval Architecture	4
E 362	Ship Form and Graphics	4
E 363	Ship Statics	3
E 461	Ship Design I	4
E 462	Ship Resistance and Propulsion	3
E 463	Ship Structures	4
E 471	Ship Design II	4
E 472	Propeller Design (Optional Offering)	2
E 473	Ship Dynamics	3

OCEAN ENGINEERING

E 412	Ocean Engineering	3
E 413	Ocean Engineering Design I	4
E 414	Ocean Engineering Design II	4

OPERATIONAL COURSES

E 502	Summer Sea Term I - Operations I	3
E 503	Manufacturing Processes I	1
E 504	Manufacturing Processes II	1
E 507	Summer Sea Term II - Operations II	4
E 511	Summer Sea Term III - Operations III	5
E 512	Summer Sea Term III - Seminar	3
E 513	Ship Systems I	2
E 514	Ship Systmes II	4
E 515	Ship Systems III	3.

The Engineering Department staff includes the following:

Berman, D.W., B.F.A., Instructor
Chu, Fen-Dow, Ph.D., Associate Professor
Femenia, J., Professor and Chairman of Engineering
Koenig, G., Ph.D., Assistant Professor
Kramer, A.R., M.M.E., Professor
Mathieson, J.L., M.M.E., Professor
McNeill, J.G., Ed.D., Professor
Miller, S.J., B.E., Second Engineer, Engineering Watch Officer and Technical Specialist
Munsch, C.J., M.E., Instructor
Parekh, J.P., Ph.D., Associate Professor
Pfelging, E.F., B.S., Chief Engineer, Professor
Weis, A.F., Ph.D., Assistant Professor
Wennagel, N.G., M.M.E., Chief Engineer, Professor

Youngren, C.C., M.A., First Engineering, Assistant Professor
Zubely, R.B., M.S. (M.E.), Professor

To obtain further information on Engineer Programs, address all inquiries directly to:

Professor Jose Femenia, Chairman
Department of Engineering
S.U.N.Y Maritime College
Fort Schuyler, Bronx, New York 10465

For information on special programs and administration of the Graduate School, address all inquiries to:

Dr. Michael F. Haines, Director
Continuing Education
S.U.N.Y. Maritime College
Fort Schuyler, Bronx, New York 10465

STEPHENS COLLEGE
Columbia, Missouri 65215

Stephens College, a private college for women, offers marine sciences courses at its temporary marine station at Key Largo, Florida, during each summer session. Supporting coursework is offered on the main campus at Columbia, Missouri. Boats and facilities, including both dormitory and laboratory space, are rented at Key Largo for the program. Faculty, with laboratory equipment and a library, are moved from the main campus to Key Largo to conduct the program. The program is designed for the female undergraduate student who wishes a biological science program with an emphasis in marine biology.

The following degrees are offered:

1. The Associate in Arts degree concentrating in Biology with an emphasis in marine biology (two-year program).

2. The Bachelor of Arts degree majoring in biology with an emphasis in marine biology (four-year program).

The following courses are offered in conjunction with the above degree programs. Credit for each course is listed in terms of courses of credit where one (1) course credit is equivalent to three (3) semester hours of credit of traditional systems:

BIOLOGY

Bio	111	Biological Concepts	2
Bio	231	Botany	2
Bio	236	Zoology	2
Bio	270	Field Biology	1
Bio	280	General Physiology	1
Bio	292	Montane Biology	1
Bio	311	Microbiology	1
Bio	322	Biology of Flowering Plants	1
Bio	333	Mammalogy	1
Bio	341	Entomology	1
Bio	343	Histology	1
Bio	346	Human Anatomy and Physiology	2
Bio	348	Biology of Aging	1
Bio	356	Biological Basis of Behavior	1
Bio	360	Embryology	1
Bio	370	Genetics	1
Bio	379	Homeostatic Mechanisms	1
Bio	381	Ecology	1
Bio	430	Evolution	1
Bio	441	Systematics	1
Bio	495	Research Internship	1

MARINE BIOLOGY

Bio	290	Marine Biology	1
Bio	390	Projects in Marine Biology	1

NATURAL SCIENCE

NS	111	Natural Science	1
NS	131	Floriculture	½
NS	141	Conservation of Natural Resources	1
NS	221	Elemental Survival	½
NS	225	Scientific Photography and Illustration	½
NS	230	Home and Graden Pest Management	1
NS	316	Environmental Studies	1
NS	333	Practicum: ________	½-2½
NS	451	Interdisciplinary Science Seminar	0-½

CHEMISTRY

Chem	111	General College Chemistry I	2
Chem	112	General College Chemistry II	2
Chem	341	Organic Chemistry I	2
Chem	342	Organic Chemistry II	2
Chem	410	Biochemistry	1½
Chem	495	Research Internship	1

GEOLOGY

GLC	111	Geological Concepts	2
GLC	212	Advanced General Geology	2
GLC	217	Geology of Our National Parks and Monuments	1
GLC	235	Historical Geology	1
GLC	277	Physical Mineralogy	1½
GLC	311	Petrology	1½
[illegible]	[illegible]	Field Geology	1
[illegible]	329	Paleobotany	1
GLC	341	Geology of the Ozarks	1
GLC	412	Invertebrate Paleontology	2

HEALTH SCIENCE

HS	205	Community Health	1

PHYSICS

PHY	211	College Physics I	1½
PHY	212	College Physics II	1½

Faculty members for the above described program are as follows (faculty are listed without rank since Stephens College has no ranking system):

(Please see next page)

Anderson, Harold, Ph.D.
Hansen, Harry, Ph.D.
Hoerter, James, Ph.D.
Howell, Lee, Ph.D.
Leun, Charles, M.S.
McClure, James, Ph.D.
Novak, Alfred, Ph.D.
Otto, David, Ph.D.
Ryan, Edward, M.A.
Saunders, Richard, M.A.

To obtain further information, address inquiries to:

Dr. David A. Otto, Director
Marine Sciences
Department of Natural Sciences
Stephens College
Columbia, Missouri 65201
(314) 442-2211, Ext. 475

STEVENS INSTITUTE OF TECHNOLOGY
Hoboken, New Jersey 07030

The Davidson Laboratory is the center for research in ocean engineering at Stevens. The major facilities include: a 320-foot towing tank suitable for model studies of ships and other structures in regular or irregular seas; a 75-foot square basin for model tests on course stability and maneuvering characteristics of ships and submersibles; a 130-foot towing tank for yacht testing; and an enclosed wind tunnel with 2.5 x 3.5 x 12-foot test section and a maximum wind speed capability of 200 feet/second. Stevens has recently joined the New Jersey Marine Sciences Consortium. The facilities and resources of the consortium will be available to faculty and students in the Ocean Engineering Department for both research and instruction. A 26-foot catamaran is also available for field work in the adjacent rivers and bays.

The following degrees are offered:

1. Doctor of Philosophy. The program leading to the Doctor of Philosophy degree is designed to develop a student's capability to perform basic research or high-level design in ocean engineering.

All students entering the doctoral program must have a master's degree or equivalent. Students who have not earned their master's degree in the Department of Ocean Engineering must take all of the required courses of the Master of Engineering (Ocean) degree, except if they have taken comparable courses in other institutions.

In addition to having completed courses equivalent to a master's degree, all doctoral students must pass an oral qualifying examination to test the student's capability for advanced study. The doctoral candidate will be expected to participate in the department's advanced seminar course, OE 280. The balance of the candidate's coursework should be composed of advanced ocean engineering courses and electives in other engineering departments as prescribed in his study plan.

Upon completion of formal coursework and before starting dissertation research, the doctoral candidate must pass the written preliminary examination.

2. Master of Engineering (Ocean). A program of study leading to a master's degree should contain at least eight courses in ocean engineering. Four courses, which are considered basic to all areas within this field of study are Oceanography (OE 101), Stochastic Analysis of Ocean Waves (OE 205), Fluid Dynamics for Ocean Engineering I (OE 200), and Dynamic Oceanography (OE 203). The remaining credits required for the master's degree can be obtained by either taking all coursework or by additional work including a master's thesis.

GRADUATE COURSES

OCEAN ENGINEERING

OE 101	Oceanography	2.5
OE 103	Seminar in Ocean Engineering	2.5
OE 125	Principles of Naval Architecture	2.5
OE 127	Laboratory in Naval Architecture	2.5
OE 130	Yacht Design	2.5
OE 141	Acoustics	2.5
OE 143	Acoustics Laboratory	2.5
OE 200	Fluid Dynamics for Ocean Engineering I	2.5
OE 201	Fluid Dynamics for Ocean Engineering II	2.5
OE 203	Dynamic Oceanography	2.5
OE 205	Stochastic Analysis of Ocean Waves	2.5
OE 215	Estuarine Oceanography	2.5
OE 220	Dynamics of Ocean Waves	2.5
OE 222	Stability and Control of Marine Craft	2.5
OE 221	Motion of Vessels in Waves	2.5
OE 223	Design of Marine Propulsors	2.5
OE 224	Hydrodynamics of High-Speed Marine Craft	2.5
OE 231	Vibrational Response of Ocean Structures	2.5
OE 240	Underwater Acoustics	2.5
OE 242	Air-Sea Interactions: Theory and Measurement	2.5
OE 250	Optimal Control of Marine Systems	2.5
OE 251	Optimal Estimation for Ocean Engineers	2.5
OE 253	Topics in Marine Structures I	2.5
OE 254	Topics in Marine Structures II	2.5
OE 280	Special Topics in Ocean Engineering	2.5
OE 400	Special Problems in Ocean Engineering	1-3
OE 401	Special Problems in Ocean Engineering	1-3
OE 500	Thesis in Ocean Engineering	5
OE 600	Research in Ocean Engineering	Arranged

DEPARTMENT OF OCEAN ENGINEERING

Breslin, John P., D.Sc., Chairman and Professor
DeSaix, P., M.E., Visiting Lecturer
Eda, Haruzo, D.Sc., Research Associate Professor
Henry, Charles J., D.Sc., Research Associate Professor
Hires, Richard I., Ph.D., Associate Professor
Kim, Cheung Hun, Dr. Ing., Research Associate Professor

Savitsky, Daniel, Ph.D., Associate Professor
Tsakonas, Stavros, Ph.D., Research Associate Professor

DEPARTMENT OF MECHANICAL ENGINEERING

Nickerson, Richard J., D.Sc., Professor

To obtain further information, address inquiries to:

Dr. Richard I. Hires
Department of Ocean Engineering
Stevens Institute of Technology
Castle Point Station
Hoboken, New Jersey 07030
(201) 792-2700, Ext. 571

SUFFOLK COUNTY COMMUNITY COLLEGE
Riverhead, New York 11901

MARINE TECHNOLOGY

The goal of this curriculum is to provide qualified high school graduates with a program of coordinated technical and general education courses at the college level which will enable them to function as technicians in marine biology laboratories, conservation agencies, commercial fishing, seafood processing, and allied marine industries.

The Marine Technology Curriculum is designed primarily as a career program; however, students may transfer to four-year college programs in the marine sciences after successful completion of this curriculum.

The following degree is offered:

A.A.S. Degree in Marine Technology. The following courses are offered in conjunction with the above program:

First Semester

	Freshman English (according to placement)	3
MR 18	Introduction to Marine Science	4
MB 21	Marine Biology	4
MA 47	Applied Mathematics (or placement)	3
	Social Science Elective	3
		17

Second Semester

	English Elective	3
MR 20	Marine Instrumentation	4
MR 26	Commercial Fishing, Navigation and Seamanship	4
ET 10	Environmental Problems of Pollution	2
	Social Science Elective	3
		16

Third Semester

MR 25	Elements of Oceanography	4
MR 30	Marine Ichthyology	4
MR 35	Marine Microbiology	4
MR 44	Commercial Marine Products	2
		14

Fourth Semester

MR 38	Fundamentals of Mariculture	4
MR 45	Elements of Ecology	4
ET 30	Biology of Water Pollution	4
ES 50	Marine Geology	4
		16

Total credits required - 63

The instructional staff for the courses listed above consists of the following:

McCarthy, Charles, Instructor of Marine Technology, M.A.
Smith, Walter, Professor of Marine Technology, M.S.

To obtain further information, address inquiries to:

Professor Walter Smith
Suffolk County Community College
Eastern Campus
Speonk Riverhead Road
Riverhead, New York 11901

SUFFOLK UNIVERSITY
Boston, Massachusetts 02114

The University offers coursework in the marine sciences at its Boston location and at the marine field station at Edmunds, Maine. The main campus has laboratory facilities which have been modernized and expanded through renovation of pre-existing facilities. The renovation has provided new facilities in the form of an environmental room for maintaining marine organisms, Atomic Energy Commission-licensed facilities for radio-biological studies and additional laboratories for marine and non-marine studies.

The Edmunds, Maine facility is presently under development as a 40-acre waterfront facility on Cobscook Bay. An all-purpose building has been constructed to house kitchen and lavatory facilities used in support of activities associated with camping. The building has a stockroom, a conference and seminar area, and a classroom-laboratory component which are utilized principally during inclement weather. Additional facilities include two house trailers converted to laboratories, an outdoor circulating seawater system and seven cabins used for camping. The New Hampshire Colleges and University

Council-Suffolk University consortium for marine sciences is cooperating in the development and use of this station. The purposes of the station are to serve undergraduate and teacher education interest.

Suffolk University offers three degree programs which allow for coursework in the marine sciences: B.A., B.S. and M.A. in Education. These programs are mostly identified with the biology curriculum and to a large extent with teachers in-service as science teachers. No degrees are offered in oceanography or marine sciences, but a program does exist in environmental technology (marine) within the biology major.

The following courses are offered in conjunction with the above degree programs:

UNDERGRADUATE COURSES

Bio	1.7	Underwater Collecting Technique	1
Sci	2.1	Introduction to Marine Science	4
Sci	2.2	Environmental Technology	12
Bio	2.5	Cryptogamic Botany	4
Bio	3.5	Ecology	4
Bio	3.51	Field Ecology	4
Bio	3.7	Marine Botany	4
Bio	3.9	Physiological Ecology	4
Bio	4.1	General Physiology	4
Bio	4.2	General Physiology	4
Bio	4.3	Invertebrate Zoology	4
Bio	4.4	Invertebrate Zoology	4
M.Sci	2.11	Marine Ecology	4
M.Sci	2.12	Marine Geology	4
M.Sci	2.13	Marine Chemistry	4

UNDERGRADUATE/GRADUATE COURSES

Bio	3.3	Parasitology	4
Bio	4.8	Natural History of Marine Plants	4
Bio	4.9	Natural History of Marine Invertebrates	4
Bio	5	Seminar	1-2
Bio	10	Directed Studies	3-4

GRADUATE COURSES

Bio	56.0	Biology of Marine Organisms	6

The instructional staff for the courses listed above consists of the following:

Comeau, Gerald, A.S., Lecturer in Biology
Fiore, James, Ph.D., Assistant Professor of Biology
Friedman, Robert S., Ph.D., Professor of Biology
Mulvey, Phillip F., Jr., Ph.D., Professor of Biology
Romach, Eileen, Ph.D., Assistant Professor of Biology
Snow, Beatrice L., Ph.D., Chairman and Associate Professor of Biology
West, Arthur J., II, Ph.D., Professor of Biology and Director of Marine Station

Special lecturers in the marine science courses include:

Burns, Richard, Ph.D., Assistant Professor of Biology
Loop, Taylor, M.S., Assistant Professor of Geology

Special Guest Lecturers in the graduate course include:

Gerachi, Joseph R., Ph.D., Marine Vertebrates
Lamb, I. MacKenzie, D.Sc., Marine Algology
Sherman, Kenneth A., M.S., Biological Oceanography
Simon, Joseph L., Ph.D., Marine Invertebrates

To obtain further information, address inquiries to:

William F. Coughlin, Director
Admissions
Suffolk University
41 Temple Street
Boston, Massachusetts 02114

TALLADEGA COLLEGE
Talladega, Alabama 35160

Talladega College Marine Sciences Program employs the teaching and research facilities of the Marine Environmental Sciences Consortium (MESC).

The principal facilities are at the Dauphin Island Research Laboratories on Dauphin Islnad in Mobile Bay. The Dauphin Island Sea Lab is located on a 36-acre portion of a former U.S. Air Force radar base with seven permanent and five temporary buildings. The Marine Science Hall contains over 5,000 square feet of instructional labs and classrooms, over 2,000 square feet of research space and 850 square feet of office space. A scientific collection of over 1,000 species is within easy access of laboratories and classrooms. Instrumentation available includes gas chromatography, atomic absorption spectrophotometer, balances, thin-layer chromatography, calculators, and the usual complement of laboratory materials. Field gear includes current meters, oxygen meter, plankton nets, corers, data buoys, transmissometers, water quality monitors, a variety of trawls and other nets for collecting, bottom grabs, photometer, refractometer, pH meter and a variety of water samplers. The Sea Lab can accommodate 250 persons in residence; support facilities include an apartment building, two dormitories, cafeteria, 13 three-bedroom family houses, and maintenance shops. Research vessels available for class and research activities include: R/V G.A. Rounsefell - 65-foot steel, diesel powered; R/V Flying Tiger - 40-foot fiber glass, twin diesel powered; 33-foot wood, diesel powered shallow water vessel; three outboards (14 feet to 23 feet).

No degrees in marine sciences are offered, however, a student may earn a certificate of attainment after completing two summers of marine science courses. The certificate will accompany a degree in a traditional major in one of the academic disciplines at Talladega College.

The following courses are offered in conjunction with the above program:

COURSES

MS 101	Marine Biology	4
MS 221	Marine Invertebrate Zoology I	4
MS 226	Marine Botany	4
MS 104	Coastal Ornithology	4
MS 105	Marine Geology	4
MS 301	Marine Technical Methods I	2
MS 250	Coastal Climatology	2
MS 230	Commercial Marine Fisheries of Alabama	2
MS 390	Seminar	1
MS 395	Research on Special Topics	1-6
MS 200	Marine Ecology	4
MS 220	Marine Invertebrate Zoology II	4
MS 222	Marine Vertebrate Zoology	4
MS 350	Introduction to Oceanography	4
MS 202	Marsh Ecology	4
MS 351	Recent Marine Sedimentation	4
MS 362	Marine Technical Methods II	2

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Heard, Richard W., Jr., Ph.D., Research Associate, Dauphin Island Sea Lab

Holliman, Dan C., Ph.D., Professor of Biology, Birmingham-Southern College

Ivester, M. Susan, Ph.D., Assistant Professor of Biology, University of Alabama

Morrill, Joy Frances, Ph.D., Associate Professor and Director of Marine Sciences, Jackson State University

Shipp, Robert L., Ph.D., Associate Professor of Biological Sciences, University of South Alabama

Stiles, Robert A., Ph.D., Assistant Professor, Samford University

Stout, Judy P., M.S., Research Biologist

EARTH SCIENCE

Lamb, George Marion, Ph.D., Professor and Chairman of the Department of Geology and Geography, University of South Alabama

Schroeder, William W., Ph.D., Associate Professor of Biology, University of Alabama

Taylor, Ronald S., Ph.D., Associate Professor, Auburn University

Williams, Aaron, Ph.D., Associate Professor of Geography, University of South Alabama

To obtain further information, address inquiries to:

Dr. Arthur L. Bacon, Chairman
Biology Department and Division of Natural Sciences and Mathematics
Talladega College
Talladega, Alabama 35160

TARLETON STATE UNIVERSITY
Stephenville, Texas 76402

Tarleton State University offers a B.S. degree in Biological Science with emphasis in Marine Biology. The marine program is offered in cooperation with Texas A&M University's Moody College at Galveston, Texas. All basic coursework is taken on the Tarleton campus with summer courses available from A&M's Galveston laboratory.

In addition to general university requirements for graduation, students take courses in general biology, microbiology, heredity, invertebrate zoology, ecology, oceanography, introduction to marine biology, marine ecology, physical geology, biostatistics, physics, and chemistry through organic. Science electives may be selected from: invertebrate paleontology, sedimentology, ichthyology, population dynamics, limnology, aquatic environment, parasitology, animal or plant physiology, biology of mammals, and systematic zoology. Other electives are available in the Department of Physical Sciences.

Tarleton State University is part of the Texas A&M University System and is located on a 125-acre campus at Stephenville, 65 miles southwest of Fort Worth, Texas. Biological and physical sciences is housed in a 56,423-square foot science building. Facilities are well equipped for systematic, ecological and physiological studies. Current marine research includes: systematics, ecology, and distribution of brachyuran crabs of the West Indies; and ecological studies of Caribbean coral reefs.

An M.S.T. is offered in Biological Sciences. Research and non-research programs are offered. Grants, work programs, loans, assistantships and scholarships are available through the student financial aid office.

The following courses are offered at Tarleton State University in conjunction with the above programs. Additional courses are available during the summer at Moody College.

DEPARTMENT OF BIOLOGICAL SCIENCES

1204	General Biology (plant emphasis	4
1214	General Biology (animal emphasis)	4
2034	Fundamentals of Microbiology	4
3303	Heredity	3
3403	Introduction to Marine Biology	3
3464	Ichthyology	4
3494	Invertebrate Zoology	4
4014	Ecology	4
4023	Population Dynamics	3
4414	Limnology	4
4423	Marine Ecology	3
4861	Biology Problems	1-4
5053	Principles and Methods of Systematic Zoology	3
5213	The Aquatic Environment	3
5861	Research Problems	1-6
5983	Quantitative Biology	3

DEPARTMENT OF PHYSICAL SCIENCES

Geology

1054	Physical Geology	4
3053	Invertebrate Paleontology	3

3103	Geomorphology	3
3133	Sedimentology	3
3403	Introduction to Oceanography	3

Chemistry

1064-1084	General Chemistry	8
2014-2024	Organic Chemistry	8
4084	Instrumental Analysis	4
4744	Introductory Biological Chemistry	4
5103	Environmental Chemistry	3

The instructional staff for the courses listed above consists of the following:

BIOLOGICAL SCIENCES

Calahan, John S., Ph.D., Assistant Professor
Eller, R. Roy, Ph.D., Assistant Professor
Garner, Herschel W., Ph.D., Associate Professor
Johanson, Lamar, Ph.D., Professor and Head
Keith, Donald E., Ph.D., Assistant Professor
Knovicka, James J., Ph.D., Associate Professor
Morrison, Eston O., Ph.D., Professor

PHYSICAL SCIENCES

Fain, Robert C., Ph.D., Professor of Chemistry
Henningson, Elmer R., M.S., Associate Professor of Geology
Hinkson, Thomas C., Ph.D., Professor of Chemistry and Head
McSwain, James L., M.S., Assistant Professor of Geology
Walker, Rueben H., Ph.D., Assistant Professor of Chemistry

To obtain further information, address inquiries to:

Dr. Donald E. Keith
Department of Biological Sciences
Tarleton State University
Tarleton Station
Stephenville, Texas 76402

TEXAS A&M UNIVERSITY
College Station, Texas 77843

Texas A&M University's major marine facilities are located on the main campus at College Station and at the Mitchell Campus and Fort Crockett in Galveston.

The University's Departments of Oceanography and Meteorology are housed in a 15-story building on the main campus. This will-equipped teaching and research complex is complemented by a staging and docking facility at the Mitchell Campus on Pelican Island, Galveston. The Oceanography Department operates R/V Gyre, a 170-foot ocean-going ship which is outfitted for deep-sea studies. It carries a crew of 11 and a scientific party of 18 and has a cruising range of 8,000 miles. The Department also operates the 36-foot R/V La Mer II. In 1974, the Department's teaching and research activities were expanded with the delivery of a 20-foot, two-man submersible, DRV Diaphus. The vessel can operate at depths of 1,200 feet and can sustain a maximum speed of approximately two knots for one hour, a slower speed for four hours, and can remain stationary for extended periods. A new wing to the Biological Sciences Building provides additional laboratory facilities for biology and wildlife and fisheries sciences. Cooperative programs exist to provide field laboratories for students and faculty. For example, the Department of Fisheries and Wildlife Sciences is working with Houston Lighting and Power Co. to study problems associated with new and existing power generating plants.

The Environmental Engineering Division of the Civil Engineering Department carries out a broad teaching and research program with particular emphasis in estuarine water quality. The division operates a field laboratory on Galveston Bay. A well-equipped laboratory on the College Station campus supports the field programs. The division operates three research vessels which dock at the field laboratory. The 56-foot R/V Excellence, the 62-foot R/V Duet and the 50-foot R/V Mariner.

The division's research program includes analytical water quality models for coastal and estuarine areas, evaluation of pollutant and quality parameter mass balances in coastal aquatic systems, water quality management methods, reaeration, hazardous materials control, advanced waste treatment and water reclamation.

The Hydromechanics Laboratory serving the Ocean Engineering program was established in February, 1969, to study the major Gulf Coast bays and estuaries. The Laboratory has facilities for research and teaching, including large, equipped wave tanks, wave-sediment basins, recirculating flumes and wave/current flumes, and field measurement equipment such as current meters, "wave-rider" buoys and pressure-type wave guages.

The Center for Dredging Studies was established in June, 1968, in response to renewed interest in greater utilization and exploitation of minerals from the ocean floor and increased dredging activities in estuarines and offshore. A modern dredging laboratory was added in 1970.

Moody College, created in 1971, is the marine and maritime component of The Texas A&M University System and is located on two campuses, Mitchell Campus and Fort Crockett campus, in Galveston. The College consists of the School of Marine Technology, Texas Maritime Academy, and Coastal Zone Laboratory. The degree programs offered are four-year courses of study with majors in Marine Biology, Marine Engineering, Marine Sciences, Marine Transportation, Maritime Administration and Maritime Systems Engineering. All programs, except Maritime Administration and Maritime Systems Engineering, offer directly, or as an option, training leading toward qualification for a U.S. Coast Guard license as a Third Mate or Third Assistant Engineer.

The Mitchell Campus of Moody College encompasses 100 acres on Pelican Island in Galveston Bay and has seven buildings: a dormitory, student center, classroom/laboratory building, classroom building, engineering building, central services building and Texas A&M University Department of Oceanography's marine staging and storing facility, as well as wharfage for the 473-foot, 15,000 ton, Texas Maritime Academy training ship Texas Clipper.

The Fort Crockett campus consists of a three-story building on one and one-half acres of Galveston Island. The College's primary research laboratory, the laboratory facilities for the upper-level biology courses, the Radar Observer School, the Coastal Zone Laboratory and various support activities occupy this campus.

The College also features a Summer-School-at-Sea program where students can earn six college credits during the months between high school graduation and enrollment as a College Freshman in a regular academic year. The training vessel, T/S Texas Clipper, serves as a classroom for the work/study program. The Clipper, a converted cargo/passenger liner has an annual cruise to foreign ports for cadets and summer school freshman participants.

The Maritime Academy, one of six State Maritime Academies in the country, administers the license curriculum for its students. Students are part of a cadet corp and live either aboard the T/S Texas Clipper or in the Moody College dormitory. Cadets in the license program may apply for one of the 35 federal subsidies awarded to eligible incoming freshmen in the U.S. Maritime Service Corp of Cadets.

The Department of Wildlife and Fisheries Sciences has research and extension programs in marine fisheries at the Corpus Christi Research and Extension Center. This facility has laboratories and offices that house and support faculty and student research in mariculture. Shrimp mariculture and environmental research are equally important activities in the marine orientation of this center. Its proximity to the estuaries, bays, and ports make it can especially attractive site for research in the Lower Gulf Coast region of the state.

The Department of Animal Science has research and extension programs in seafood technology located in the new Kleberg Center on the West Campus. These facilities consist of modern, well-equipped laboratories to perform chemical, microbiological and technological studies of seafoods and seafood products. It also has offices and facilities for the seafood extension specialist and consumer education specialist. A seafood technology laboratory is located at the Texas A&M Agricultural Research and Extension Center in Corpus Christi.

The following degrees are offered:

1. B.S. in Marine Biology. This program offers training in the biology of coastal and marine environments. It is structured to provide the student with not only a strong basis of formal academic instruction, but also considerable hands-on field and collectionexperience by taking advantage of the coastal location of the College. A general core of courses during the freshman and sophomore years provides foundation for specialization during junior and senior years through the liberal program of electives.

High school preparation should include biology, chemistry, physical sciences and mathematics.

Graduates of this program will be prepared for general marine biology careers or may wish to further their studies at the graduate level. Potential career areas include: marine biology, marine pharmacology, marine medicine, fisheries biology, biological oceanography, aquatic ecology, environmental sciences and various levels of teaching in marine biology.

2. B.S. in Marine Sciences. This program takes the generalist approach with a combination of courses in humanities, sciences and various marine subjects. The program takes advantage of the coastal location of the College to provide the student with extensive hands-on experience in addition to a solid base of formal academic instruction in the science of the coastal, estuarine and marine environments. A general core of courses during the freshman and sophomore years provides a foundation for specialization during the junior and senior years through a liberal program of electives. This curriculum emphasizes mathematics, life sciences, physical sciences and earth sciences.

High school preparation should include biology, chemistry, physical sciences, and mathematics.

Graduates of this program will be prepared for general marine science careers or may wish to further their studies at the graduate level. Potential career areas include: marine geology, marine biology, oceanography, marine geography, environmental sciences and various levels of teaching in marine science.

3. B.S. in Maritime Systems Engineering. This program is for the students inclined toward the physical ocean sciences and ocean engineering. The Maritime Systems Engineering curriculum concentrates on the fundamental engineering design in combination with humanities, sceinces and various marine subjects. The general core of courses in humanities, sciences and engineering during the freshman and sophomore years provides a foundation for specialization in one of the options (Ocean Engineering, Coastal Structures, or Hydro-Mechanics) during the junior and senior years. The program is designed to train students for work or further study in any marine oriented engineering field. A thorough preparation in mathematics, sciences and basic applied engineering subjects is recommended for students pursuing this degree program.

Graduates are prepared for numerous jobs in the maritime and ocean industries. Job opportunities in this area include design of various coastal and offshore structures, undersea pipelines, mobile drilling vessels, offshore ports, surface effect vehicles, hydrofoil vehicles, etc. Students may also further their studies at the graduate level in areas of physical oceanography, advanced ocean engineering and environmental engineering.

4. B.S. in Marine Transportation. This license-oriented academic program consists of eight academic semesters and three summer training cruises. Cruises are 10 weeks in duration and are taken aboard the T/S Texas Clipper. This program combines studies in humanities and sciences with instruction and training in maritime disciplines to provide the U.S. Maritime Service cadet with a broad-based education. The student who successfully completes the license program will be qualified to take the U.S. Coast Guard license as a Third Mate, Steam and Motor Vessels, Oceans, Unlimited.

High school preparation should include mathematics, english and chemistry.

5. B.S. in Marine Engineering. The Marine Engineering program emphasizes the theory, design, operation and maintenance of maritime power plants and associated equipment. Engineering theory and practice are coordinated by relating classroom study to the students' practical experience aboard the T/S Texas Clipper. Thorough preparation in mathematics, sciences and basic and applied engineering subjects is recommended for students pursuing this degree program. An option leading toward U.S. Coast Guard licensing is available to U.S. Maritime Service Cadets through the Marine Engineering curriculum. The student who successfully completes the license program will be qualified to take the U.S. Coast Guard license examination for Third Assistant Engineer, Steam and Motor Vessels, Unlimited Horsepower.

6. B.S. in Maritime Administration. This curriculum administered by the Department of Marine Transportation, is designed to prepare the graduate for work in the administration of the coastal and maritime industries or government organizations involved in coastal marine and maritime affairs. The curriculum provides a strong foundation in management, finance, marketing, accounting, and economics. This foundation then becomes a basis for courses that specialize in various aspects of marine and maritime industries such as port operations, brokerage and chartering, maritime law and inland waterway.

7. M.S. in Biology, Botany, Microbiology or Zoology (marine emphasis). Students who are candidates for an M.S. degree are required to obtain practical experience in some phase of marine biology and to demonstrate competence by satisfactorily completing a comprehensive examination and a thesis project. Each student is required to satisfactorily complete 32 hours of coursework, eight of which will be credited for successfully completing an acceptable research thesis. (3)

8. Ph.D. in Biology, Botany, Microbiology or Zoology (marine emphasis). Students are required to obtain practical research experience in areas of marine emphasis. Though there are no absolute course requirements, each doctoral candidate is expected to complete at least 96 semester hours above a B.S. (B.A.) or 64 semester hours beyond an M.S. (M.A.). To qualify for the preliminary examination, the student must satisfy the language work, excluding dissertation research credits. The examination is both oral and written unless otherwise recommended and approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research. (4)

9. M.E. in Civil Engineering with a program in environmental engineering. The Master of Engineering degree requires a minimum of 36 semester hours of which one third is taken in fields other than the major field. A thesis is not required. With these exceptions, requirements are the same as those for the Master of Science degree. (3)

10. M.S. in Civil Engineering with a program in environmental engineering. The Master of Science degree program requires a minimum of two full semesters of approved courses and research (32 semester hours). This requirement is ordinarily met by completing at least 24 hours of coursework and up to eight hours of research. A thesis embodying original work is required. The student is required to pass a final examination, covering his graduate programs, which is administered by the student's graduate committee and may be either written or oral. (9)

11. Ph.D. in Civil Engineering with a program in environmental engineering. The doctoral degree requires a minimum of six full semesters of acceptable advanced study (96 hours of research and formal courses above a bachelor's degree). To qualify for the preliminary examination, the student must have completed all but approximately six hours of the formal coursework on his degree program excluding dissertation research credits. The examination is both oral and written unless otherwise recommended and approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research. (9)

12. B.S. in Wildlife and Fisheries Sciences with an option in wildlife ecology, natural history, fisheries ecology, aquaculture, teaching or museum science. Entering freshman enroll in a program of two semesters of basic courses. At the beginning of the sophomore year, the student selects one of seven options. The junior and senior years are oriented toward specialization in the option selected. Emphasis is on programs which are designed to train individuals in the science of wildlife and fishery management and ecology, aquaculture and mariculture; for research in the ecology, systematics, zoogeography and general science, conservation of natural resources, biology, and zoology, and for positions as exhibit specialists, curators and allied work in museums and nature centers. (56)

13. M. Agr. in Fisheries Science or Wildlife Science. In this non-thesis degree approximately 12 of the 36 required credit hours are taken outside the student's option. Each candidate is required to obtain practical experience in his chosen option by fulfilling an internship and is required to prepare one or more written reports on the internship experience. The reports are expected to be of a scholarly nature and may carry up to four hours of credit. (5)

14. M.S. in Wildlife and Fisheries Science. Students who are candidates for an M.S. degree are required to demonstrate competence by satisfactorily completing a comprehensive examination and a thesis project. Each student is required to satisfactorily complete 32 hours of coursework, eight of which will be credited for successfully completing an acceptable research thesis. (12)

15. Ph.D. in Wildlife and Fisheries Science. Students are required to obtain research experience in the areas of fisheries science or wildlife science emphasis. Though there are no absolute course requirements, each doctoral candidate is expected to complete at least 96 semester hours above a B.S. (B.A.) or 64 semester hours beyond an M.S. (M.A.). To qualify for the preliminary examination, the student must complete all but approximately six hours of his formal coursework, excluding dissertation research credits. The examination is both oral and written unless otherwise recommended or approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research. (3)

16. M.S. in Food Technology. In addition to Food Technology courses, students in the Department of Animal Science can take Marine Biology of Fishery courses subject to approval of the student's Graduate Committee. The student conducts research on technological problems of handling, preservation and utilization of marine organisms. Each student is required to complete 32 hours of coursework.

17. Ph.D. in Food Technology. Students majoring in Food Technology in the Department of Animal Science may take Marine Biology and Fisheries courses, subject to the approval of the student's Graduate Committee. The student conducts research on technological problems of handling, preservation and utilization of marine organisms.

18. B.S. in Agricultural Economics. The curricula in agricultural economics is designed to train graduates for a wide variety of jobs in agriculturally-oriented business firms and government agencies. Sufficient flexibility is included in the curricula so that a student, in consultation with his faculty advisor, can develop a degree program which best fits personal career objectives.

Options available in agricultural economics are: (1) agribusiness, (2) farm and ranch management, (3) food and fiber marketing, (4) resources economics, and (5) rural development. The course requirements are the same during the freshman and sophomore years for all options. Students may select an option at any time, but must do so prior to registering for their junior year.

19. M.S. in Agricultural Economics. The program of study leading to the degree of Master of Agriculture in Agricultural Economics is designed to serve those who desire graduate professional training without a research orientation. The objective of the degree is to provide graduate studies for students interested in managerial or service careers in agriculture and related businesses. Students electing this option normally do not plan to do graduate work beyond the Masters. A professional internship and a written problems paper are required. The minimum 36 credit hours are from both Agricultural Economics courses and from other departments, depending upon the program of study selected by the student. Considerable flexibility in course requirements is permitted to meet special interests.

20. M.S. in Agricultural Economics. The Degree of Master of Science in Agricultural Economics is designed to provide the student with training in economic theory and application of theory to the agricultural and marine sector of the economy. Training helps students identify the basic nature of problems and conduct and interpret research. There are two Master of Science Options -- thesis and non-thesis. Each candidate is expected to demonstrate competency by satisfactorily completing a thesis based on original research if the thesis option is selected and a well-documented research paper if the non-thesis option is selected. An oral examination covering both the research and coursework is required.

21. Ph.D. in Agricultural Economics. The doctoral program in Agricultural Economics is designed to develop competence in advanced economic theory, in techniques of analysis and in the application of both to economic problems in agriculture. These programs have been designed to take advantage of the strengths of the Department of Agricultural Economics and the supporting disciplines of Economics, Statistics, and Wildlife and Fisheries Sciences. A program with different emphasis in the supporting areas is possible with the approval of the Departmental Graduate Advisory Committee. Each candidate is expected to demonstrate competency by satisfactorily completing (1) a comprehensive written examination in each specialty field of study chosen, (2) a dissertation demonstrating original independent scholarly research and (3) a final oral examination.

22. M.S. in Management with a Marine Resources Management Specialization. The curriculum consists of a minimum of 36 semester hours to a maximum of 51 hours, depending upon business-related courses the student has previously completed. Of this total, a minimum of 24 hours needs to be in management, largely focusing on various aspects of marine resources management, and a minimum of six hours in a supporting field. Students with no prior background in business administration subjects may be required to take up to 27 semester hours of foundation coursework in areas such as accounting, business analysis, economics, finance, management, and marketing.

The M.S. degree also provides the opportunity to complete a thesis (six semester hours) as well as a professional paper (three semester hours). These activities may be substituted for coursework.

23. M.B.A. with a Marine Resources Management Specialization. The basic curriculum consists of a minimum of 36 to a maximum of 60 semester hours, depending upon the business-related courses the student has previously completed. Regardless of backgroun, all students complete the "professional core", which consists of 21 semester hours in the fields of accounting, business analysis, economics, finance, management, and marketing. Fifteen semester hours are normally taken in the marine resources management specialization area. A limited number of elective hours of coursework may also be taken in other areas.

24. M.P.A. with supporting area in Marine Resources Policy and Administration. Through the Department of Political Science, the College of Liberal Arts offers an interdisciplinary, non-thesis program leading to the degree of Master of Public Administration under joint auspices with the College of Business Administration and the cooperation of the College of Engineering. This 36-hour program usually includes an additional six hours of internship, and consists of a general administrative core, an analytical core, six hours of electives, and nine to 15 hours in a supporting area, one of which is Marine Resources Policy and Administration in the Department of Management. The normal core of activity for this supprting area includes study in Marine Resources Management, Marine and Coastal Zone Law, and Coastal Zone Management, and it occurs in the broader context of other requirements for the M.P.A. degree.

25. B.S. in Ocean Engineering. This degree program is oriented toward the student who desires an engineering degree which will prepare him for designing and constructing structures and other works in the estuaries, along the shore and offshore. The program is structured so that basic and applied engineering is combined with courses in all branches of oceanography to acquaint the student with the ocean environment. A large number of elective courses are available to permit the student a certain degree of specialization. The degree is fully accredited by E.C.P.D.

26. M.S. in Ocean Engineering. Students can specialize in any area of ocean engineering after taking 15 credit hours of required courses in mathematics, hydromechanics, coastal engineering and physical oceanography. The Master of Science degree program requires a minimum of two full semesters of approved courses and research (32 semester hours). This requirement is ordinarily met by completing at least 27 hours of coursework and up to five hours of research. A thesis embodying original work is

required. The student is required to pass a final examination which may be written and oral, or oral and is conducted by the student's Advisory Committees.

27. M.E. in Ocean Engineering. Approximately one third of the required 36 credit hours of coursework is taken in fields outside of the major field for the M.E. degree. A thesis is not required, but the work in the major field will include one or two written reports for which up to four hours of credit is permissible. With these exceptions, requirements are the same as those for the Master of Science degree.

28. Ph.D. in Ocean Engineering. The students can specialize in one or more areas of ocean engineering and are guided by the Advisory Committee consisting of not fewer than four members of the Graduate Faculty representative of the student's several fields of study and research. The students with baccalaureate degrees must spend two academic years in resident study on the main campus in College Station. Those who hold a Master's degree must spend one academic year in resident study on the main campus. A minimum of 96 credit hours beyond the baccalaureate degree or 64 credit hours beyond the Master's degree is normally required for the degree of Doctor of Philosophy. A qualifying examination of a preliminary examination (both written and oral) are required. Following successful completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research. The final examination may cover the broad field of the candidate's training, but the major portion of the time will be devoted to the dissertation and closely allied topics.

29. Ph.D. in Engineering. The Doctor of Engineering Program has as its objective the education of men and women to function at the highest levels of the engineering profession, with emphasis on solving problems which arise in the utilization of technology to benefit mankind. The curriculum includes a 68 semester hour pre-professional program and 160 semester credit hour professional program which includes an internship. The professional programs are administered by the departments in the College of Engineering, together with the College of Engineering and the Graduate College.

30. M.S. in Oceanography. A minimum of two full semesters of approved courses and research (32 semester hours) are required for the Master of Science degree. Ordinarily the student devotes the major portion of this time to work in one field or two closely related fields. Other work is in supporting fields of interest. Generally, not less than one-third of the coursework, excluding research, is taken in one or more fields outside the major field.

Specialization may be undertaken for both the M.S. and Ph.D. degrees in biological, chemical, geological, meteorological and physical oceanography. An effort is made to maintain a balance between the biological, chemical, geological, geophysical and physical aspects of oceanography both in teaching and research.

31. Ph.D. in Oceanography. To qualify for the preliminary examination, the student must have satisfied the language requirement and have completed all but approximately six hours of the formal coursewrok on his degree program, excluding dissertation research credits. The examination is both oral and written unless otherwise recommended or approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research.

32. B.S. in Geophysics. Students may obtain a B.S. degree in Geophysics with a marine emphasis by taking various oceanography courses as electives. The program includes strong preparation in Geology, Mathematics and Physics as well as Geophysics. Graduates would be qualified to participate in offshore geophysical exploration programs designed to search for minerals.

33. M.S. in Geophysics. Students interested in marine aspects of Geophysics would take courses in Oceanography and perform research in the marine environment. The M.S. program requires a thesis which would related to marine aspects of Geophysics, such as geophysical exploration at sea, measurement and analysis of marine seismic, magnetic, gravity and bathymetric data and its geological/geophysical interpretation.

34. Ph.D. in Geophysics. Students with interests in Marine Geophysics may elect to complete a Ph.D. program in this subject area. The program is similar to the M.S. program except that the Ph.D. dissertation research topic would be more substantive than that treated for the M.S.

35. M. Agr. in Recreation and Resources Development with a specialization in marine recreation management development. A minimum of 40 hours of graduate credit beyond the bachelors is required for the professional degree. Coursework is split between major and supporting fields. Each candidate is required to prepare two professional papers for credit in addition to a six-month internship.

36. M.S. in Recreation and Resources Development with a specialization in marine recreation management/development. This degree requires the satisfactory completion of 32 hours of coursework, eight hours of which will be credited upon completion of an acceptable thesis. The remaining coursework may be split between the Recreation and Parks Department and supporting fields to meet individual coursework needs.

37. Ph.D. in Recreation and Resources Development with a specialization in marine recreation management/development. Each doctoral candidate must complete a minimum of 64 hours beyond the master's degree. Coursework may be divided between major and two supporting fields by agreement with graduate committee. To qualify for the preliminary examination, the student must have completed all but approximately six hours of the formal coursework on his degree program, excluding dissertation research credits. The examination is both oral and written. Following the preliminary examination, the candidate pursues a dissertation problem to demonstrate his research capability.

38. M.A. in Anthroplogy (nautical archaeology emphasis). Students who are candiates for this degree are expected to gain a general background in the history of seafaring, wooden hull construction, conservation of underwater antiquities, and underwater excavation techniques. Most decide to specialize in Old World or New World shipping. Knowledge of one modern foreign language, 30 hours of coursework, and a thesis are required. Opportunities for field experience exist both from University projects, and from joint projects with the Institute of Nautical Archaeology which is affiliated with Texas A&M University.

39. Master of Urban Planning. The Master of Urban Planning graduate program as accredited by the American Institute of Certified Planners provides for specialization in coastal zone management. This specialization follows completion of the student's 26 hours of required core courses. Coastal zone management is taught as a special application of planning within the context of the state and federal legislation in the field. Approximately 16 hours of additional graduate work and a six credit hour internship are required. The degree program is typically developed on interdisciplinary basis in close cooperation with geology, oceanography, business management, civil engineering and others. The internship required of all Urban and Regional Planning students in the case of a person with this specialty ordinarily will be solved with a regional planning agency in a coastal area or with a state or federal agency administrating coastal zone programs.

40. D.E.D. in Regional Science. The Doctor of Environmental Design degree in Urban and Regional Science is an academic degree comparable to a Ph.D. The student has wide latitude in selecting a specific research topic which relates to marine or coastal zone issues. Typically students with this interest come to the department from geography, marine sciences, environmental sciences, and other disciplines concerned with ecological systems in sensitive coastal areas. The student will concentrate on a specific topic as for example the utilization of sensitive areas for recreation purposes by nearby urban population centers without undue adverse impacts upon biosystems important for agriculture and fishing or energy resources exploration. A total of 96 credit hours beyond the baccalaureate are required or 64 hours beyond a master's program or equivalent. The student is required to spend two consecutive semesters in residence and may pursue other research efforts related to his dissertation away from the main campus. Acceptable graduate courses taken elsewhere may be transferred into this degree program in accordance with the regulations of the Graduate College.

41. M.S. in Veterinary Microbiology with primary emphasis on diseases of fish and shellfish. The program is available to Doctors of Veterinary Medicine and others with exceptional qualifications. The basic curriculum consists of at least 24 hours of coursework and up to eight hours of research in the areas of bacteriology, virology, mycology or immunology of aquatic animals. A thesis embodying original work is required. The student is required to pass a final oral examination administered by his graduate committee. (4)

42. Ph.D. in Veterinary Microbiology with primary emphasis on diseases of fish and shellfish. The program is available to Doctors of Veterinary Medicine and others with exceptional qualifications. The doctoral degree program requires a minimum of six full semesters of acceptable advanced study (96 hours of research and formal courses above a bachelor's degree). The student will have completed most of his formal coursework prior to the preliminary examination. The examination is both written and oral unless otherwise recommended and approved. Following completion of the preliminary examination, the student pursues a dissertation to demonstrate his capability for independent research. (1)

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Ag.Ec.	325	Principles of Farm and Ranch Management	3
Ag.Ec.	330	Introduction to Agricultural Finance	3
Ag.Ec.	314	Marketing Agricultural Products	3
Ag.Ec.	350	Economics of Environmental Quality as Related to Agriculture	3
Ag.Ec.	415	Economics of Food Distribution	3
Ag.Ec.	440	Economics of Agriculture Business	3
Biol.	113	Introductory Biology	3
Biol.	114	Introductory Biology	3
Biol.	123	Introductory Biology Laboratory	1
Biol.	124	Introductory Biology Laboratory	1
Biol.	330	Life Science	3
Biol.	357	Invertebrate Ecology	4
Biol.	408	Biology of the Algae	4
Biol.	435	Advanced Intertebrate Zoology	4
Biol.	436	Animal Parasitology	4
Biol.	440	Marine Biology	4
Biol.	441	Comparative Animal Physiology	4
Biol.	459	Aquatic Biology	3
Biol.	466	Principles of Evaluation	3
Biol.	481	Seminar in Biology	1
Biol.	482	Seminar in Biology	1
Biol.	485	Biological Problems	1-4
C.E.	301	Water and Sewage Treatment	3
C.E.	311	Fluid Dynamics	4
C.E.	336	Fluid Dynamics Laboratory	1
C.E.	338	Water Resources Engineering	2
C.E.	402	Water Supply and Sewage Practice	3
C.E.	403	Sanitary Design	3
C.E.	406	Sanitation and Public Health	3
C.E.	458	Hydraulic Engineering	3
C.E.	462	Hydrodynamics	3
C.E.	463	Hydrology	3
C.E.	481	Seminar	1
C.E.	485	Problems	1-3
Ento.	313	Biology of Insects	3
Geog.	210	Marine Geography	3
Geog.	315	Geography of the Sea	3
Geog.	316	Underwater Culture History	3
Geog.	320	Geography of the Pacific Basin	3
Geol.	105	Physical Geology	4
Geol.	106	Historical Geology	4
Geol.	305	Invertebrate Paleontology	3
Geol.	423	Micropaleontology	3
Geol.	441	Advanced Engineering Geology	4
Geop.	213	Exploration of the Earth and Moon	1
Geop.	214	Introduction to Exploration Geophysics	1
Geop.	301	The Dynamic Earth	3
Geop.	435	Principles of Geophysical Exploration	3-3
Geop.	436	Seismic Wave Propagation	3-3
Geop.	446	Physics of the Earth	3
Geop.	450	Geophysical Data Processing	3
Geop.	475	Interpretation of Gravity and Magnetic Fields	3
Geop.	485	Problems	1-4
MARA	211	Legal and Social Environment Business	3
MARA	363	The Organizing Process	3
MARA	401	Brokerage and Chartering	3

MARA	402	Inland Waterways	3
MARA	422	Personnel Management	3
MARA	423	Organization Behavior	3
MARA	460	Management Systems and Control	3
MARA	466	Management Policy	3

MARB	310	Introduction to Cell Biology	4
MARB	311	Ichthyology	3
MARB	312	Field Ichthyology	3
MARB	408	Biology of the Algae	4
MARB	415	Invertebrate Fisheries	3
MARB	418	Fisheries Population Dynamics	3
MARB	420	Comparative Physiology	4
MARB	425	Marine Biology	3
MARB	435	Invertebrate Zoology	4
MARB	450	Developmental Biology of Marine Organisms	4
MARB	481	Seminar in Marine Biology	1
MARB	482	Seminar in Marine Biology	1
MARB	485	Problems in Marine Biology	1-6
MARB	489	Special Topics in Marine Biology	1-4

MARE	101	Engineering Analysis	1
MARE	105	Engineering Mechanics I	3
MARE	200	Basic Operations	4
MARE	202	Introduction to Marine Engineering Operations	4
MARE	203	Diesel Engine Technology	3
MARE	206	Engineering Mechanics II	3
MARE	207	Electricity and Magnetism	4
MARE	209	Mechanics of Materials	3
MARE	210	Marine Construction Materials	4
MARE	216	Kinematic Drawing	1
MARE	300	Intermediate Operations	4
MARE	301	Heat Transfer	3
MARE	303	Marine Thermodynamics	3
MARE	304	Marine Thermodynamics	3
MARE	305	Introduction to Marine Nuclear Engineering	4
MARE	306	Marine Refrigeration and Air Conditioning	3
MARE	307	Electrical Circuits	4
MARE	308	Electrical Machinery	4
MARE	310	Engineering Computation	3
MARE	400	Advanced Operations	4
MARE	401	Nuclear Propulsion I	4
MARE	403	Marine Steam and Gas Turbines	3
MARE	405	Steam Generators	3
MARE	407	Marine Electronics Technology	4
MARE	408	Nuclear Propulsion II	3
MARE	410	Marine Power Plants	3
MARE	411	Marine Mechanical Design Technology	3
MARE	412	Ship Structures and Stability	3
MARE	414	Ship Automation I	4
MARE	415	Introduction to Marine Engineering Systems Design	3
MARE	416	Engineering Laboratory I	1
MARE	417	Engineering Laboratory II	1
MARE	418	Fundamentals of Radiation Control	3
MARE	420	Ship Automation II	4
MARE	485	Problems	1-4

MARS	310	Field Methods of Marine Science	3
MARS	320	Coastal Zone Environments	3
MARS	440	Marine Biology	4
MARS	481	Seminar	1
MARS	485	Problems	1-6
MARS	489	Selected Topics	1-4

MART	301	Ocean Transportation I	4
MART	302	Marine Cargo Operations I	4
MART	304	Ocean Transportation II	3
MART	321	Maritime Law I	3
MART	402	Ocean Transportation III	4
MART	406	Marine Cargo Operations II	3
MART	416	Port Operations, Administration and Economics	3
MART	421	Maritime Law II	3
MART	481	Seminar	1
MART	485	Problems	1-4
MART	489	Special Topics in Marine Transportation	1-3

MASE	100	Introduction to Maritime Systems Engineering	3
MASE	375	Science of Fluids	3
MASE	411	Advanced Hydrodynamics I	3
MASE	412	Advanced Hydrodynamics II	3
MASE	485	Problems in Maritime Systems	1-4
MASE	489	Special Topics in Maritime Systems Engineering	1-4

Met.	203	Introduction to Weather and Climate	1
Met.	301	Atmospheric Science	3
Met.	302	Weather Reports and Forecasting	3
Met.	305	General Meteorology	3
Met.	324	Physical and Regional Climatology	3
Met.	455	Atmospheric Physical Processes	3
Met.	463	Air Pollution Meteorology	3
Met.	467	Marine Meteorology	3
Met.	485	Problems	1-3

NAUT	103	Maritime Orientation and Lifesaving	3
NAUT	200	Basic Communications, Navigation, and Seamanship	4
NAUT	201	Naval Architecture I	4
NAUT	202	Naval Architecture II	3
NAUT	203	Seamanship I	
NAUT	204	Terrestrial Navigation	3
NAUT	300	Intermediate Communications, Navigation, and Seamanship	4
NAUT	301	Seamanship II	3
NAUT	302	Seamanship III	2
NAUT	303	Celestial Navigation	3
NAUT	304	Electronic Navigation	3
NAUT	400	Advanced Communications, Navigation, and Seamanship	4
NAUT	401	Seamanship IV	3
NAUT	404	The Navigator	3

NAVS	110	Introduction to Naval Science	1
NAVS	112	Naval Ship Systems I	3
NAVS	210	Naval Ship Systems II	3
NAVS	212	Sea Power and Maritime Affairs	1
NAVS	315	Navigation	3
NAVS	316	Naval Operations Analysis	3
NAVS	411	Principles of Naval Organization and Management	3
NAVS	414	The Junior Naval Officer	1
NAVS	485	Problems	1-4

OE	300	Dynamics of Waves and Structures	3
OE	400	Basic Coastal Engineering	3
OE	401	Measurements in the Ocean	4
OE	402	Principles of Naval Architecture	3
OE	403	Estuary Engineering	3
OE	407	Design of Ocean Engineering Facilities	4
OE	408	Introduction to Life Support and Diving Technology	2
OE	481	Seminar	1
OE	485	Advanced Problems in Ocean Engineering	1-6
OE	489	Special Topics in Ocean Engineering	3

Ocn.	205	Introduction to Ocean Studies	1
Ocn.	401	Introduction to Oceanography	3
Ocn.	410	Introduction to Physical Oceanography	3

Ocn.	420	Introduction to Biological Oceanography	2
Ocn.	430	Introduction to Geological Oceanography	2
Ocn.	440	Introduction to Chemical Oceanography	2
R.P.	301	Outdoor Recreation	3
R.P.	316	Wilderness Recreation Management	3
R.P.	375	Conservation of Natural Resources	3
R.P.	460	Development of Recreation Resources	3
V.Mi.	406	Aquatic Animal Microbiology	4
V.Mi.	597	Viruses of Laboratory, Marine and Exotic Animals	3
V.Mi.	598	Introduction to Diseases of Food Fish	3
W.F.S.	304	Conservation and Management of Fishes	3
W.F.S.	311	Ichthyology	3
W.F.S.	312	Field Ichthyology	3
W.F.S.	400	Fisheries Survey	4
W.F.S.	403	Animal Ecology	3
W.F.S.	408	Techniques of Wildlife Management	3
W.F.S.	410	Conservation and Management of Fishes	3
W.F.S.	414	Limnology	3
W.F.S.	415	Invertebrate Fisheries	3
W.F.S.	417	Biology of Fishes	3
W.F.S.	418	Fisheries Population Dynamics	3
W.F.S.	423	Aquaculture	3
W.F.S.	424	Aquaculture Laboratory	1
W.F.S.	485	Wildlife Problems	1-3
W.F.S.	489	Special Topics	1-4

GRADUATE COURSES

Ag.Ec.	611	Production Economics	3
Ag.Ec.	617	Market Development Research Theory	3
Ag.Ec.	630	Financial Planning of the Farm Firm	3
Ag.Ec.	634	Economics of Agricultural Production	3
Ag.Ec.	655	Agricultural Marketing Operations	3
Anth.	612	Preclassical Seafaring	3
Anth.	613	Classical Seafaring	3
Anth.	614	Medieval Seafaring (not yet official)	3
Anth.	615	History of Wooden Ship Construction	3
Anth.	616	Research and Reconstruction of Ships	3
Anth.	689	Special Topics in Historical Archaeology	1-4
Anth.	689	Special Topics in Antiquities Conservation	1-4
Biol.	608	Phycology	4
Biol.	609	Invertebrate Pathology	4
Biol.	612	Biology of Estuarine Organisms	3
Biol.	613	Sensory Physiology of Fish Behavior	3
Biol.	627	Helminthology	4
Biol.	630	Protozoology	4
Biol.	637	Marine Botany	4
Biol.	651	Mycology	4
Biol.	653	Zoogeography	3
Biol.	660	Aquatic Ecology	1
Biol.	662	Biology of the Mollusca	4
Biol.	663	Biology of the Crustacea	4
Biol.	665	Biology of Invertebrates	4
Biol.	666	Aerospace-Hydrospace Physiology	3
Biol.	667	Physiology of Host-Parasite Systems	3
Biol.	668	Biology of Animal Symbioses	4
Biol.	681	Seminar	1
Biol.	685	Problems	1-6
Biol.	691	Research	1
C.E.	603	Stream Quality	3
C.E.	605	Experimental Analysis in Environmental Engineering	3
C.E.	606	Design of Waste Water Treatment Systems	3
C.E.	609	Simulation of Water Resources Systems of Numerical Analysis	3
C.E.	610	Industrial Wastes	3
C.E.	611	Design of Portable and Industrial Water Systems	3
C.E.	627	Hydrology	3
C.E.	628	Hydraulic Engineering	3
C.E.	629	Hydraulics of Open Channels	3
C.E.	637	Pipeline Construction	2
C.E.	664	Water Resources Development	3
C.E.	678	Hydromechanics	3
C.E.	679	Theory of Fluid Mechanics Models	3
C.E.	680	Civil Engineering Computer Systems	3
C.E.	681	Seminar	1
C.E.	685	Problems	1-6
C.E.	686	Offshore and Coastal Structures	3
C.E.	687	Marine Foundation Engineering	3
C.E.	688	Marine Dredging	3
C.E.	691	Research	1
Econ.	621	Regional Science I	3
Ento.	605	Aquatic Entomology	4
Ento.	609	Invertebrate Pathology	4
Ento.	619	Insect Toxicology	4
Fin.	670	Planning, Programming, Budgeting	3
FST	605	Chemistry of Foods	3
FST	606	Microbiology of Foods	3
FST	608	Seafood Preservation and Processing	4
Geog.	610	Geography of Water Transport	3
Geog.	614	Eastern Seafaring	3
Geog.	619	Man's Impact on Hin Environment	3
Geog.	620	Man and Nature	3
Geog.	626	River Basin Development	3
Geog.	627	Coastal Geomorphology	3
Geog.	641	Exploration and Discovery	3
Geog.	642	Exploration and Discovery II	3
Geol.	618	Sedimentation	3
Geol.	622	Stratigraphy	3
Geol.	650	Paleoecology	3
Geol.	662	Sedimentation	3
Geol.	681	Seminar	1
Geol.	685	Problems	1-6
Geol.	691	Research	1
Geop.	604	Marine Geophysics	4
Geop.	606	Kinematic Aspects of Plate Tectonics	2
Geop.	611	Geomechanics	3
Geop.	614	Continuum Mechanics of Geologic Materials	3
Geop.	637	Electromagnetic Wave Propagation in Earth Materials	3
Geop.	651	Theoretical Seismology	3
Geop.	653	Analysis of Gravity and Magnetic Fields	3
Geop.	657	Planetary Interiors	3
Geop.	666	Principles of Geodynamics	4
Geop.	681	Seminar	1
Geop.	685	Problems	1-4
Geop.	691	Research	1
Mgmt.	615	Environmental Law	3
Mgmt.	661	Marine Resources Management	3
Mgmt.	662	Marine and Coastal Zone Law	3
Mgmt.	664	Coastal Zone Management	3
Mgmt.	684	Professional Internship	1-6
Mgmt.	685	Management Problems	1-4
OE	630	Dynamics of Ocean Vehicles	3
OE	675	Coastal Engineering I	3
OE	676	Ocean Engineering	3
OE	677	Coastal Engineering II	3

OE	681	Seminar	1
OE	682	Coastal Sediment Processes	3
OE	683	Estuary Hydrodynamics	3
OE	685	Problems	1-6
OE	686	Offshore and Coastal Structures	3
OE	687	Marine Foundation Engineering	3
OE	688	Marine Dredging	3
Ocn.	600	Survey of Oceanography	3
Ocn.	602	Ocean Research and Operational Techniques	3
Ocn.	604	Biological Oceanography Cruise	2
Ocn.	605	Chemical Oceanography Cruise	2
Ocn.	606	Geological Oceanography Cruise	2
Ocn.	607	Physical Oceanography Cruise	2
Ocn.	608	Physical Oceanography	4
Ocn.	609	Physical Oceanography	3
Ocn.	611	Theoretical Physical Oceanography	3
Ocn.	612	Elements of Ocean Wave Theory	3
Ocn.	614	Dynamics of the Ocean and Atmosphere	3
Ocn.	615	Long Waves and Tides	4
Ocn.	617	Theories of Ocean Circulation	3
Ocn.	620	Biological Oceanography	3
Ocn.	621	Open-Ocean Physiological Ecology	3
Ocn.	622	Analysis of Benthic Communities	3
Ocn.	623	Marine Zooplankton	3
Ocn.	624	Marine Phytoplankton	3
Ocn.	625	Deep-Sea Pelagic and Demersal Fishes	3
Ocn.	626	Organic Cycles of the Sea	3
Ocn.	627	Ecology of the Continental Shelf	3
Ocn.	628	Biology of Coral Reefs	3
Ocn.	629	Field Studies on Atlantic Coral Reefs	2
Ocn.	630	Geological Oceanography	3
Ocn.	631	Geological Oceanography	3
Ocn.	633	Carbonate Sediments I	2
Ocn.	634	Carbonate Sediments II	3
Ocn.	635	Techniques in Geological Oceanography	4
Ocn.	636	Marine Biostratigraphy I	3
Ocn.	637	Marine Biostratigraphy II	3
Ocn.	638	Simulation Techniques	4
Ocn.	639	Lithophycology	3
Ocn.	640	Chemical Oceanography	3
Ocn.	641	Chemical Oceanography	3
Ocn.	642	Marine Chemistry of the Nutrient Elements	3
Ocn.	643	Geochemistry of the Ocean	3
Ocn.	644	Isotope Geochemistry	3
Ocn.	645	Marine Organic Geochemistry	3
Ocn.	646	Quantitative Marine Biochemistry	3
Ocn.	647	Chemical Contamination of Marine Environment	3
Ocn.	651	Meteorological Oceanography	3
Ocn.	652	Ocean Boundary Layer Problems	3
Ocn.	653	Synoptic Physical Oceanography	3
Ocn.	665	Invertebrate Biochemistry and Biochemical Ecology	3
Ocn.	666	Principles of Geodynamics	4
Ocn.	681	Seminar	1
Ocn.	685	Problems	1-4
Ocn.	689	Special Topics in Oceanography	3
Ocn.	691	Research	1
Pol.S.	632	International Law	3
R.P.	650	Recreation Resource Development	3
R.P.	660	Environmental Impact-Analysis for R.P.	3-0
R.P.	666	Recreation Management/Development in Coastal Zone	3-0
V.M.	660	Diseases of Marine Invertebrates	4
V.M.	661	Diseases of Fish	4
W.F.S.	604	Wildlife and Fisheries Systems Analysis	3
W.F.S.	605	Systematic Ichthyology	3
W.F.S.	609	Wildlife Research Methods	3
W.F.S.	611	Estuarine Ecology	4
W.F.S.	612	Marine Ichthyology	3
W.F.S.	613	Shore and Estuarine Fishes	4
W.F.S.	614	Biological Limnology	4
W.F.S.	615	Mariculture	4
W.F.S.	616	Physiological Ecology of Vertebrates	4
W.F.S.	618	Dynamics of Fish Populations	3
W.F.S.	619	Analytical Procedures in Fisheries	3
W.F.S.	681	Seminar	1
W.F.S.	684	Professional Internship	1-4
W.F.S.	685	Problems	2-6
W.F.S.	689	Special Topics	1-4
W.F.S.	691	Research	1

The instructional staff for the courses listed above consists of the following:

AGRICULTURAL ECONOMICS

Griffin, Wade, L., Ph.D., Associate Professor
Nichols, John P., Ph.D., Associate Professor

ANIMAL SCIENCE

Finne, G., Ph.D., Assistant Professor
Vanderzant, Carl, Ph.D., Professor

ARCHITECTURE AND ENVIRONMENTAL DESIGN

Roeseler, W.G., Ph.D., Professor

BIOLOGY

Cox, Elenor R., Ph.D., Associate Professor
Dronen, Norman, Ph.D., Assistant Professor
Fife, William P., Ph.D., Professor
Neff, Jerry M., Ph.D., Associate Professor
Owens, David W., Ph.D., Assistant Professor
Sweet, Merrill H., Ph.D., Associate Professor
Taber, Willard A., Ph.D., Professor

CHEMISTRY

Giam, C.S., Ph.D., Professor

CIVIL ENGINEERING

Allison, Richard C., Ph.D., Assistant Professor
Ball, John E., Ph.D., Assistant Professor
Basco, David R., Ph.D., P.E., Assistant Professor
Burnett, Neill C., Ph.D., Engineering Research Associate
Coyle, Harry M., Ph.D., Associate Professor
Dunlap, Wayne A., Ph.D., Associate Professor
Flipse, John E., M.S., P.E., Professor
Hann, Roy W., Ph.D., Professor
Herbich, John B., Ph.D., P.E., Professor
Hughes, J. Martin, M.S., Assistant Professor
James, Wesley P., Ph.D., Assistant Professor
Lowery, L.L., Ph.D., Associate Professor
McCoy, Patrick T., Ph.D., Associate Professor
Niedzwecki, John M., Ph.D., P.E., Assistant Professor
Schiller, Robert E., Ph.D., Associate Professor
Sparr, Ted M., Ph.D., Assistant Professor
Su, Joe T.C., Ph.D., Assistant Professor
Wolf, Harold W., Ph.D., Professor

ENTOMOLOGY

Plapp, Frederick W., Ph.D., Professor
Schaffner, Joseph C., Ph.D., Professor
Summers, Max D., Ph.D., Professor

GEOGRAPHY

Carter, George F., Ph.D., Professor
Cook, Earl, Ph.D., Professor and Dean of Geosciences
Doran, Edwin B., Ph.D., Professor
Kimber, Clarissa T., Ph.D., Associate Professor

GEOLOGY

Ahr, Wayne M., Ph.D., Associate Professor
Mathewson, Christopher C., Ph.D., Associate Professor
Scott, Robert B., Ph.D., Associate Professor
Tieh, Thomas T., Ph.D., Associate Professor

GEOPHYSICS

Carlson, R.L., Ph.D., Assistant Professor
Fahlquist, D.A., Ph.D., Professor
Gangi, A.F., Ph.D., Professor
Hilde, T.W.C., D.Sc., Associate Professor
Jones, G.A., Ph.D., Assistant Professor
Spencer, T.W., Ph.D., Professor
Unterberger, R.R., Ph.D., Professor

MANAGEMENT

Hellriegel, Don, Ph.D., Professor
King, Lauriston R., Ph.D., Assistant Professor
Seymour, John L., J.D., LL.M., Assistant Professor

MARINE BIOLOGY (Galveston)

Aldrich, David V., Ph.D., Professor
Alexander, Steve, Ph.D., Lecturer
Harper, Donald E., Ph.D., Assistant Professor
Kanz, James E., Ph.D., Assistant Professor
Landry, Andre M., Ph.D., Assistant Professor
Mangum, Dorothea C., Ph.D., Associate Professor
Park, Edward T., Ph.D., Associate Professor
Ray, Sammy M., Ph.D., Professor
Schwarz, John R., Ph.D., Assistant Professor and Assistant Dean for Academic Affairs
Webb, James, Ph.D., Lecturer
Wilson, William B., Ph.D., Professor

MARINE ENGINEERING (Galveston)

Johnson, Bruce, B.B.A., Lecturer
Kuhns, Robert L., M.S., Assistant Professor
Moore, John A., B.S., Lecturer
Nelson, James K., Jr., M.S., Lecturer
Ralston, Durward O., M.S., Lecturer
Tormollan, Francis C., M.S., Associate Professor
Wiggins, Edwin G., Ph.D., Assistant Professor and Head

MARINE SCIENCE (Galveston)

Amsbury, David, Ph.D., Lecturer
Coleman, Charles, B.S., Lab Instructor
Estes, Ernest L., Ph.D., Associate Professor and Head
Griffin, Lawrence L., Ph.D., Assistant Professor
Harris, David L., M.A., Lecturer
Hughes, Thomas, B.S., Lab Instructor
Klein, Douglas, Ph.D., Assistant Professor
Mickey, Charles D., Ph.D., Associate Professor
Moore, Sylvia, B.S., Lab Instructor
Morrow, Cindy L., B.S., Lab Instructor
O'Brien, William P., Ph.D., Visiting Assistant Professor
Phillips, T.J., M.S., Lecturer
Schery, Stephen D., Ph.D., Assistant Professor (on leave)
Schlemmer, Frederick C., II, Ph.D., Assistant Professor and Assistant to the President
Seitz, William A., Ph.D., Assistant Professor
Smith, Mary M., M.Ed., Lecturer
Whittemore, Kenneth C., B.A., Lecturer

MARITIME SYSTEMS ENGINEERING (Galveston)

Bullock, Richard L., M.S., Lecturer
Garcia, Salvadore R., M.Ed., Assistant Professor
Hatley, James D., D.Ed., Associate Professor
McClenan, C. Michael, M.S., Lecturer
Nash, James M., Ph.D., Associate Professor
Nelson, James, M.S., Lecturer
Poth, Louis, M.S., Lecturer

MARINE TRANSPORTATION (Galveston)

Armstrong, Robert, B.S., Lecturer
Beyer, Donald F., B.S., Lecturer
Bunce, Robert E., B.A., Lecturer
Davis, Howard W., Ph.D., Associate Professor
Gant, Virgil, M.B.A., Assistant Professor
Haynes, Kenneth G., RADM, M.A., Professor and Superintendent of the Texas Maritime Academy
Hickman, Kyrm L., B.S., Lecturer
Hildreth, William W., Ph.D., Lecturer
McMullen, William T., M.B.A., Associate Professor
McNulty, James F., M.M.A., Assistant Professor and Head

MARKETING

Gillespie, Samuel M., Ph.D., Associate Professor

NAUTICAL ARCHEOLOGY

Bass, George F., Ph.D., Professor
Hamilton, D.L., Ph.D., Assistant Professor
Steffy, J. Richard, Lecturer
Van Doorninck, Fredrick H., Ph.D., Associate Professor

NAVAL SCIENCE (Galveston)

Brewer, Fred H., Gunners Mate, Instructor
Boney, Ronald D., LT., B.S., Associate Professor and Head
Kiehl, Thomas H., LT., B.A., Assistant Professor
Smith, Howard, LT., B.A., Assistant Professor
Whitlow, Jimmy L., Chief Machinist Mate, Instructor

METEOROLOGY

Brundidge, K.C., Ph.D., Professor and Head
Das, Phanindramohan, Ph.D., Associate Professor
Driscoll, D.M., Ph.D., Assistant Professor
Franceschini, J.A., Ph.D., Professor
Griffiths, J.A., M.S., Professor
Runnels, R.C., Ph.D., Assistant Professor

OCEAN ENGINEERING

Basco, David R., Ph.D., P.E., Associate Professor
Flipse, John E., M.S., P.E., Professor
Herbich, John B., Ph.D., Professor
James, Wesley P., Ph.D., P.E., Assistant Professor
Lou, Jack Y.K., Ph.D., P.E., Assistant Professor
Niedzwecki, John M., Ph.D., Assistant Professor
Schiller, Robert E., Ph.D., Associate Professor
Su, Joe T.C., Ph.D., Assistant Professor

OCEANOGRAPHY

Berner, Leo, Jr., Ph.D., Professor and Associate Dean of Graduate College
Biggs, Douglas C., Ph.D., Assistant Professor
Bright, Thomas J., Ph.D., Associate Professor
Brooks, David A., Ph.D., Assistant Professor
Bryant, William R., Ph.D., Professor
Cochrane, John D., M.S., Associate Professor
Darnell, Rezneat M., Professor
El-Sayed, Sayed Z., Ph.D., Professor
Fahlquist, Davis A., Ph.D., Professor (Joint appointment with Geophysics)
Gartner, Stefan, Jr., Ph.D., Associate Professor
Geyer, Richard A., Ph.D., Professor
Giam, Choo-Seng, Ph.D., Professor (Joint appointment with Chemistry)
Hilde, Thomas W.C., D.Sc., Associate Professor (Joint appointment with Geophysics)
Ichiye, Takashi, D.Sc., Professor
Jeffrey, Lela M., Ph.D., Associate Professor
McGrail, David M., Ph.D., Assistant Professor
Nowlin, Worth D., Jr., Ph.D., Lecturer
Pequegnat, Linda H., Ph.D., Lecturer
Pequegnat, Willis E., Ph.D., Assistant Professor
Powell, Eric N., Ph.D., Assistant Professor
Presley, Bobby Joe, Ph.D., Associate Professor
Reid, Robert O., M.S., Distinguished Professor
Rezak, Richard A., Ph.D., Professor
Schink, David R., Ph.D., Professor
Scott, Martha R., Ph.D., Assistant Professor
Sharman, George F., Ph.D., Assistant Professor
Spence, Thomas W., Ph.D., Assistant Professor
Treadwell, T.K., M.S., Associate Professor
Vastano, Andrew C., Ph.D., Associate Professor
Wormuth, John H., Ph.D., Associate Professor

RECREATION AND PARKS

Cheek, Neil H., Jr., Ph.D., Professor
Ditton, Robert B., Ph.D., Associate Professor
Gunn, Clare A., Ph.D., Professor
Kamp, Dan B., Ph.D., Associate Professor
Reed, David, Ph.D., Associate Professor
Van Doren, Carlton S., Ph.D., Professor

VETERINARY MICROBIOLOGY AND PARASITOLOGY

Lewis, Donald H., Ph.D., Assistant Professor
McConnell, William F., D.V.M., Professor

WILDLIFE AND FISHERIES SCIENCES

Brick, Robert W., Ph.D., Assistant Professor
Chittenden, Mark, Ph.D., Associate Professor
Clark, William J., Ph.D., Associate Professor
Grant, William E., Ph.D., Assistant Professor
Hendricks, Fred S., Ph.D., Assistant Professor
Klussmann, Wallace G., Ph.D., Professor and Head
McEachran, John D., Ph.D., Associate Professor
Neill, William H., Ph.D., Associate Professor
Noble, Richard, Ph.D., Associate Professor
Stickney, Robert R., Ph.D., Associate Professor
Strawn, R. Kirk, Ph.D., Professor

To obtain further information, address inquiries to:

Registrar
Texas A&M University
College Station, Texas 77843

TEXAS CHRISTIAN UNIVERSITY
Fort Worth, Texas 76129

Several large laboratories have been designated for marine-oriented research and include four large seawater systems. Facilities are well equipped for systematic ecological, chemical and physiological marine studies. Studies of rivers, estuaries and shallow-water marine habitats are emphasized. The University also has made arrangements for field research on Swan Island in the Caribbean.

M.S. degrees are available in biology, environmental science and geology with emphasis on marine problems.

M.S. in Environmental Science. This program is an interdisciplinary one between the Departments of Biology and Geology. All students must complete four graduate core courses. Nine hours of electives may be chosen from biology, geology or approved by the environmental sciences committee. Three hours of seminar and six hours of thesis must also be completed. Regardless of prior major discipline, the student should have a minimum of one year each of biology and chemistry and one course in physical geology. Students who do not have credit must complete at least one course in calculus and one in metropolitan and regional planning prior to completion of the degree.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF BIOLOGY

3104	Invertebrate Zoology	4
3203	Ecology	3
3323	Introduction to Marine Science	3
5713	Marine Ecology	3
5723	Aquatic Biology	3

5903	Tropical Biology	3
5214	Algal Ecology	3
6503	Fishery Biology	3
6513	Field Techniques in Environmental Biology	3
7900	Thesis Research	6

DEPARTMENT OF GEOLOGY

3313	Invertebrate Paleontology	3
5243	Geochemistry of Natural Waters	3
5313	Micropaleontology	3
5393	Environmental Geology	3
5513	Sedimentation	3
5523	Marine Geology	3
5703	Remote Sensing	3
6213	Instrumental Analysis	3
6323	Principles of Paleoecology	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGY

Britton, Joseph C., Ph.D., Associate Professor
Couch, Ernest F., Ph.D., Associate Professor
Drenner, Ray, Ph.D., Assistant Professor
Ferguson, Gary, Ph.D., Associate Professor
Kroh, Glenn, Ph.D., Assistant Professor
McCracken, Michael D., Ph.D., Associate Professor
Newland, Leo, Ph.D., Associate Professor

DEPARTMENT OF GEOLOGY

Bonem, Rena Mae, Ph.D., Assistant Professor
Breyer, John, Ph.D., Assistant Professor
Ehlmann, Arthur J., Ph.D., Professor
Morgan, Ken, Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. Joe Britton
Department of Biology
Texas Christian University
Fort Worth, Texas 76129

TUFTS UNIVERSITY
THE FLETCHER SCHOOL OF LAW AND DIPLOMACY
Medford, Massachusetts 02155

PROGRAM IN INTERNATIONAL MARINE AFFAIRS

The Fletcher School of Law and Diplomacy offers limited instruction in international marine affairs as a component of its generalist graduate curriculum in international affairs. The program is offered in cooperation with Woods Hole Oceanographic Institution, which makes available members of its faculty and its research facilities for the use of Fletcher students with particular interest in marine affairs. A number of Fletcher students have pursued advanced graduate study at Woods Hole in the marine policy field.

The Fletcher School offers no degree specifically in marine policy. The School offers the degrees of Master of Arts, Master of Arts in Law and Diplomacy, and Doctor of Philosophy in International Affairs. Studies in marine policy may comprise a part of the requirements for each degree for those students with a particular interest in the field. An estimated 50 students per year take courses having components dealing with marine policy and participate in related activities.

The requirements for the degree of Master of Arts, which is normally restricted to mid-career professionals, are completion of eight semester courses, demonstration of written and oral proficiency in a foreign language and passage of a comprehensive oral examination.

The requirements for the degree of Master of Arts in Law and Diplomacy are the completion of 16 semester courses, satisfactory presentation of a substantial research paper, demonstration of written and oral competence in a foreign language and passage of a comprehensive oral examination.

No undergraduate courses are offered.

The following courses are either offered in conjunction with the program, or contain marine-related content:

Law 200-201	Introduction to International Law	3
Law 205	Seminar on Law of the Sea	3
Law 207	Seminar on Environmental Problems and International Law	3
Law 210	International Organization	3
Law 211	Contemporary Problems of the United Nations and Regional Organizations	3
Diplomacy 207	Science, Technology and American Foreign Policy	3
Economics 243	Resources, World Trade and Development	3
Politics 211	Seminar on the Foreign Policy Implications of Scarce Resources	3

The instructional staff for the courses listed above consists of the following:

INTERNATIONAL LAW

Gross, Leo, S.J.D., Professor
Irwin, Paul, J.D., Visiting Assistant Professor
Rubin, Alfred P., J.D., M.Litt., Professor

DIPLOMACY

Pfaltzgraff, Robert L., Ph.D., Associate Professor

ECONOMICS

West, Robert L., Ph.D., Professor

POLITICS

Kemp, Geoffrey, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Mr. Jeffrey A. Sheehan
Assistant to the Dean
The Fletcher School of Law and Diplomacy
Tufts University
Medford, Massachusetts 02155
(617) 628-5000

UNITED STATES COAST GUARD ACADEMY
New London, Connecticut 06320

The U.S. Coast Guard Academy is the federal service academy for the education and training of Coast Guard Officers. The entire curriculum is designed around the sea and marine maritime affairs. Of particular interest are programs in marine science, marine engineering and ocean engineering.

Marine science courses are offered under the Department of Physical and Ocean Sciences. Special facilities include refrigerated aquariums and a series of culture tanks for marine organisms, estuarine models, a weather satellite photo receiver and a completely equipped fleet of small craft for oceanographic studies of Long Island Sound and adjacent waters. An IBM 1620 and a GE 225 computer are used in most ocean science courses and research projects. Summer programs utilize the large vessels of the Coast Guard for high seas and polar expeditions.

The courses at the Academy lead to a Bachelor of Science degree, with designation of the major study area. For marine science, the course offerings are designed to give the student a taste of deep sea oceanography and biology as well as an appreciation for the coastal environment and its problems. Students who select a marine science area as a study option complete a basic pre-science/engineering background program which consists of five semesters of math, three semesters of physics, three semesters each of nautical science and marine law, two semesters of chemistry and one semester each of mechanics, electrical science and basic naval architecture. In addition there is the program of required oceanography courses described below. Thirteen degrees in marine science, three in ocean engineering and 11 in marine engineering were awarded in 1975.

Marine Science courses offered by the Department of Physical and Ocean Sciences include:

*5218	Introduction to Marine Biology/Marine Geology	4
*5321	Physical Oceanography	4
5326	Meteorology	4
5303	Waves and Wind Currents	3.5
5418	Pollution Ecology	4
5420	Biological Oceanography	4
5422	Chemical Oceanography	4
5424	Marine Fisheries	4
5428	Coastal Processes	4

*These courses are also required for the Ocean Engineering major.

Ocean Engineering and Marine Engineering programs are offered by the Department of Engineering. Both curricula are accredited by the Engineering Council for Professional Development.

1. Common Requirements:

a) Substitute two semesters in electrical science
b) Substitute Ship Design I for Basic Naval Architecture
c) Marine Science courses, noted (*) above, required for Ocean Engineering only.

2. Major Requirements for Ocean Engineering include:

+1212	States and Strength of Materials	4
+1333	Dynamics	3
+1321	Engineering Thermodynamics	3
+1334	Material Science	3.5
1325	Ocean Wave Mechanics	3
+1315	Ocean Engineering Fluid Dynamics	3
+1471	Ocean Engineering Design II	4.5
+1499	Ship Design III (Propulsion)	4.5

+Also an area elective from courses available.

3. The Marine Engineering program, in addition to courses marked (+) above, includes:

1431	Heat Transfer	3
1495	Engineering Design and Analysis	4.5

The instructional staff for the courses listed above consists of the following:

MARINE SCIENCE

Brigham, Lawson W., Lt., USCG, B.S., Instructor
Costello, Hugh J., MALS, Associate Professor
Gehring, Howard B., LCDR, USCG, M.S., Assistant Professor
Kollmeyer, Ronald C., CDR, USCG, Ph.D., Head, Ocean Science Section, Associate Professor
McGill, David A., Ph.D., Professor
Rosebrook, Alan D., LCDR, USCG, M.S., Assistant Professor
Tolderlund, Douglas S., Ph.D., Associate Professor

ENGINEERING

Arrechi, Angelo, V., LCDR, USCG, M.S., Assistant Professor
Becker, Wayne W., LCDR, USCG, M.S.E., Assistant Professor
Boggs, Robert G., Ph.D., Professor
Duncan, Robert S., Jr., Lt., USCG, M.S.E., Instructor
Freese, David H., Jr., CDR, USCG, M.S.E.E., Associate Professor
Gathy, Bruce S., Ph.D., Professor
Hengenberger, William T., M.S., P.E., Associate Professor

Lutkus, Anthony J., Lt., USCG, M.S.E., Instructor
Mahler, Joseph, Ph.D., Associate Professor
McKaughan, Michael E., Lt., USCG, B.S.E.E., Instructor
Miller, Robert E., Ph.D., Associate Professor
Rolland, Albert E., LCDR, USCG, Ph.D., Assistant Professor
Sanial, James A., LCDR, USCG, M.S.E., Assistant Professor
Simpson, William M., LCDR, USCG, Nav. E., Assistant Professor
Skinner, Bruce C., CDR, USCG, Nav. E., Associate Professor
Stramandi, Nicholas, Lt., USCG, M.C.E., Instructor
Thompson, Claude R., Captain, USCG, Nav. E., Department Head, Professor
Vance, George P., CDR, USCG, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Office of the Director of Admissions
U.S. Coast Guard Academy
New London, Connecticut 06320

UNITED STATES MERCHANT MARINE ACADEMY
Kings Point, New York 11024

The academy's 39 building and marine facilities occupy 65 acres on the north shore of Long Island overlooking Long Island South and include academic buildings, resident halls, shops and laboratories. In addition, the academy operates miscellaneous small training craft on Long Island Sound.

The United States Merchant Marine Academy offers a four-year undergraduate program which leads to a Bachelor of Science degree and a Marchant Marine license as a Third Mate or Third Assistant Engineer. In addition, graduates are comissioned as Ensigns in the United States Naval Reserve. The Academy is accredited by the Middle States Association of Colleges and Secondary Schools.

Three major curriculums are offered: Nautical Science for the preparation of deck officers, Marine Engineering for students interested in becoming engineering officers, and a combination of the two, a Dual License curriculum, which leads to a license in each specialty. In addition to a major, each midshipman may also take a minor or a concentrate elective program in such specialized fields as oceanography, nuclear engineering, management science, computer science, mathematics, chemistry and naval architecture. General education courses make up about one third of each of the professional curriculums and all midshipmen are required to take naval science courses prescribed by the Department of the Navy.

The academic year at the Academy is divided into four academic quarters which span 11 months, from the first week of August to the end of June. As an integral part of the academic program, midshipmen spend the first half of their sophomore year and the last half of their junior year at sea.

The curriculum at the Academy is thus stimulating and comprehensive. It is designed to assure that each midshipman, upon graduation, will be professionally competent, trained for leadership and responsibility, and well-rounded intellectually.

The following courses are offered in conjunction with the above programs:

NAUTICAL SCIENCE CURRICULUM

Third Class (Sophomore Year)

M122, M224	Physics II-III	8
L221-222	Economics	6
L201	Law	4
D332	Cargo I	3
H252	History I	3
N205	Naval Weapons Systems	3
Option	Foreign Language or Anthropology	6
P205, P206	Physical Education	2

Second Class (Junior Year)

L202	Law	3
D308	Communications	2
D326	Seamanship Laboratory I	1½
D204	Safety of Life at Sea I	1½
D342	Navigation I	4
E330	Principles of Naval Architecture I	3
D251	Marine Electronics I	3
L380	Managerial Process	3
H253-254	History II-III	6
Option	Foreign Language or Anthropology	6
	Elective	6

First Class (Senior Year)

E331	Principles of Naval Architecture II	3
D433	Cargo II	3
D490	Meteorology	3½
D423	Seamanship I	3
D405, D406	Safety of Life at Sea II-III	5
D443	Navigation II	3
D452, D453	Marine Electronics II, III	6
L351	Marine Transportation	4
L370	Political Science	3
L431	Labor Relations	3
L441	Marine Insurance	2
N402	Naval Operations	4
N404	Naval Organization	2
Option	Foreign Language or Anthropology	6
	Electives	15

MARINE ENGINEERING CURRICULUM

Third Class (Sophomore Year)

M225, M226	Physics II, III	8
M206	Calculus and Analytic Geometry V	4
E243	Thermodynamics I	3
E214	Metal Joining Processes I	3/4
E211	Metal Cutting Processes I	1½
H252, H253	History II-III	6

H103	English III	3
N205	Naval Weapons Systems	3
D204	Safety of Life at Sea I	1½
E222, E223	Engineering Mechanics I, II	7

Second Class (Junior Year)

E325	Strength of Materials	4½
E344-E345	Thermodynamics II-III	7½
E350-E351	Electrical Circuits I-II	7½
E340	Fluid Mechanics I	3½
E332	Principles of Naval Architecture (E)	3
L221-L222	Economics	6
	Electives	6

First Class (Senior Year)

E460-462	Marine Engineering I, II, III	13¼
E447	Marine Refrigeration	3-3/4
E464, E465	Internal Combustion Engines I, II	7½
E448	Air Conditioning	2-3/4
L380	Managerial Process	3
L431	Labor Relations	3
L370	Political Science	3
H254	History III	3
N402	Naval Operations	4
N404	Naval Organization	2
P205, P206	Physical Education	2
Option	Humanities or Maritime Law Elective	6
	Electives	12

DUAL LICENSE CURRICULUM

Third Class (Sophomore Year)

E211	Metal Cutting Processes I	1½
E225-E226	Physics II, III	8
D332	Cargo I	3
L351	Marine Transportation	2
H252, H253	History I, II	6
E222, E223	Engineering Mechanics I, II	7
E243	Thermodynamics I	3
D326	Seamanship Laboratory I	1½
D204	Safety of Life at Sea I	1½
E330	Principles of Naval Architecture I	3
N205	Naval Weapons Systems	3
P205	Physical Education	1

Second Class (Junior Year)

D251	Marine Electronics I	3
L221, L222	Economics	6
H254	History III	3
E325	Strength of Materials	4½
E344, E345	Thermodynamics	7½
E350, E351	Electrical Circuits I, II	7½
E340	Fluid Mechanics I	3½
D342	Navigation I	4
E332	Principles of Naval Architecture	3

First Class (Senior Year)

L380	Management	3
D433	Cargo II	3
E474	Air Conditioning	2-3/4
E460-E462	Marine Engineering I, II, III	12¼
E447	Marine Refrigeration	3-3/4
E464, E465	Internal Combustion Engines I, II	7½
D490	Meteorology	3½
D423	Seamanship I	3
D405, D406	Safety of Life at Sea II-III	5
N402, N404	Naval Operations; Naval Organization	6
L202, L403	Law I, III	5
D443	Navigation II	3
D452, D453	Marine Electronics II, III	6
D308	Communications	2
L370	Political Science	3
L431	Labor Relations	3
Option	Humanities or Maritime Law Elective	6
P206	Physical Education	1

Note: A total of 15 quarter-credit-hours is given for courses completed at sea during the Third and Second Class years.

DEPARTMENT OF ENGINEERING

Minor Program in Marine Electrical Power and Control

M307	Differential Equations I	3
or		
E493	Engineering Mathematics I	3
M308	Differential Equations II	3
or		
E494	Engineering Mathematics II	3
E452	Alternating Current Machinery	3-3/4
E453	Direct Current Machinery	3-3/4
E454	Engineering Electronics I	3
E455	Engineering Electronics II	3
E470	Analog Simulation Technology	4½
E471	Automatic Control Systems I	3
E472	Automatic Control Systems II	3
E499	Independent Engineering Study and/or Research	Variable

Minor Program in Marine Machinery Design

E304	Descriptive Geometry	3
F306	Kinematics	3
E308	Marine Lofting, Sheet Metal and Piping Design	3
E312	Metal Cutting Processes II	3
E315	Metal Joining Processes II	3
E424	Mechanical Vibrations	3
E426	Stress Analysis	3
E428	Analysis and Design of Machine Elements I	3
E429	Analysis and Design of Machine Elements II	3
E468	Gas Turbines	3
E110A	Introduction to Materials Science	3
E499	Independent Engineering Study and/or Research	Variable

Minor Program in Marine Thermal Power Systems and Control

M307	Differential Equations I	3
or		
E493	Engineering Mathematics I	3
E446	Heat Transfer	3
E468	Gas Turbines	3
E471	Automatic Control Systems I	3
E490	Engineering Economics	3
E469	Engineering Problems in Power	3
E424	Mechanical Vibrations	3
E441	Fluid Mechanics II	3½
E499	Independent Engineering Study and/or Research	Variable

Minor Program in Naval Architecture

E426	Stress Analysis	3
E433	Ship Resistance and Propulsion	3
E434	Ship Dynamics	3
E435	Ship Structures	3

E436	Naval Architecture Computer Applications	3
E437	Ship Design	3
E438	Elementary Hydrodynamics	3
E439	Ship Hydrodynamics	3
E475	Ocean Engineering	3
E499	Independent Engineering Study and/or Research	Variable

Minor Program in Nuclear Engineering

M307	Differential Equations I	3
or		
E493	Engineering Mathematics I	3
M308	Differential Equations II	3
or		
E494	Engineering Mathematics II	3
M327	Atomic Physics	3
M328	Nuclear Physics	3
E470	Analog Simulation Technology	4½
E480	Nuclear Engineering I	4
E481	Nuclear Engineering II	4
E484	Nuclear Ship Propulsion	4
E489	Projects in Nuclear Science and Engineering	Variable

DEPARTMENT OF MARITIME LAW AND ECONOMICS

Minor Program in Law

L386	Government and Business	3
L405	Advanced International Law of the Sea	3
L406	Law and Society	3
L407	Environmental Law	3
L408	Law for Engineers and Scientists	3
L409	Advanced Admiralty Law	3
L441[4]	Marine Insurance	3
L483	Management and the Law	3
L489	Personal Finance	3

Minor Program in Management

L281	Accounting for Management	3
L282	Managerial Economics	3
L352	Seaport Management	3
L483	Management and the Law	3
L484	Personnel Administration	3
L485	Management Seminar	3
L491	Industrial Psychology	3
C404	Computer Programming for Business Applications I	3

Of the six required courses, not more than two may be selected from the following:

M208	Probability	3
M209	Statistics	3
M210	Decision Making Under Uncertainty	3
M311	Management Mathematics I	3
M312	Management Mathematics II	3

Minor Program in Maritime Transportation

D497	Tanker Terminal Operations	3
L352	Seaport Management	3
L386	Government and Business	3
L441[4]	Marine Insurance	3
L453	Ship Chartering and Brokerage	3
L487	Transportation Economics	3
L488	International Trade	3

Of the six required courses, not more than two may be selected from the following:

L281	Accounting for Management	3
L282	Managerial Economics	3
L483	Management and the Law	3

DEPARTMENT OF NAUTICAL SCIENCE

Minor Program in Marine Electronics

The Department of Nautical Science, in association with the Departments of Engineering and Mathematics and Science, offers a minor in Marine Electronics from which a concentration in telecommunications or automatic control systems may be selected. The Marine Electronics minor must consist of at least 18-3/4 quarter-credit-hours.

D448	Introduction to Electronic Circuits	3-3/4
D449	Electronic Circuits I	3-3/4
D450	Electronic Circuits II	3-3/4
D461[7]	Telecommunications I	3-3/4
D462[7]	Telecommunications II	3-3/4
D454	Microwave Techniques	3-3/4
M307	Differential Equations I	3
or		
E493	Engineering Mathematics I	3
E471[8]	Automatic Control Systems I	3
E472[8]	Automatic Control Systems II	3

Minor Program in Marine Petroleum Operations

D496	Theory of Marine Operations	3
D493	Tanker Operations	3
D497	Tanker Terminal Operations	3
D495	Pollution of the Oceans by Oil	3
D487	Weather Analysis for Marine Operations	3
D489	Pollution Control in the Marine Industry	3
D492	Offshore Oil Operations	3
L407	Environmental Law	3
L453	Ship Chartering and Brokerage	3

Minor Program in Oceanography

D380	Descriptive Oceanography I	3
D381	Descriptive Oceanography II	3
D382	Dynamic Oceanography I	3
D383	Dynamic Oceanography II	3
E475	Ocean Engineering	3
M346	Oceanographic Chemistry I	4
M347	Oceanographic Chemistry II	4
D489	Environmental Pollution	3
D495	Pollution of the Oceans by Oil	3
D484	Oceanographic Research Methods	3

The following courses are optional for the areas of concentration as indicated in parentheses:

(1) physical oceanography, (2) ocean chemistry, and (3) ocean pollution.

D499	Independent Physical Oceanographic Research (1)	3
M459	Independent Ocean Chemistry Research (2)	3
D498	Independent Ocean Pollution Research (3)	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF NAUTICAL SCIENCE

Browder, Richard A., Chief Warrant Officer, USMS, Laboratory Instructor

Caines, Charles F., Lieutenant Commander, USMS, Associate Professor, B.S., M.S.(Marine License: Master)

Fiore, Alfred E., Captain, USMS, Professor, Head of Department, B.S., M.S. (Marine License: Chief Mate)

Guest, Frank E., Assistant Professor, B.S., M. Div., Th.M. (Marine License: Chief Mate)

Haendel, Theodore F., Lieutenant Commander, USMS, Assistant Professor, B.S., M.S. (Marine License: Operator Ocean Towing)

Hard, Douglas A., Lieutenant Commander, USMS, Assistant Professor, B.S., M.B.A. (Marine License: Master)

Hurder, William R., Captain, USMS, Professor of Nautical Science (Marine License: Master)

Nazzaro, Pasquale, Commander, USMS, Professor, Assistant Head of Department, B.S., M.A., M.S. (Marine License: Master)

Pearson, Leland, Captain, USMS, Professor, B.S., B.A., M.S. (Marine License: Master)

Pohle, Cortland G., Commander, USMS, Associate Professor, B.S., B.S.E.E., M.S. (License: FCC First Class Radiotelephone)

Thompson, Owen E., Commander, USMS, Associate Professor, B.S. (Marine License: Chief Mate)

Wichert, William A.A., Commander, USMS, Associate Professor, B.S. (Marine License: Second Mate)

DEPARTMENT OF ENGINEERING

Antell, Jonas, Laboratory Instructor

Burghardt, David, Associate Professor, B.S., M.S., Ph.D. (Marine License: Third Assistant, Steam and Diesel; Professional Engineer License, New York)

Drucker, Jules H., Professor, M.E., M.S. (Marine License: First Engineer; Professional Engineer License, New York and New Jersey)

Ferenczy, Edward D., Commander, USMS, Associate Professor, M.E., M.S. (Marine License: Chief Engineer, Steam)

Giaquinto, Joseph A., Lieutenant, USMS, Assistant Professor, B.S.

Gross, Maurice, Captain, USMS, Professor, Assistant Head of Department, B.S., B.M.E., M.M.E. (Marine License: Chief Engineer, Steam; Professional Engineer License, New York)

Hirschkowitz, Moses W., Captain, USMS, Professor, B.M.E., M.M.E. (Marine License: Chief Engineer, Steam; Third Engineer, Diesel; Professional Engineer License, New York; Atomic Energy Commission Reactor License, NS Savannah)

Hsiung, Chi-Chao, Lieutenant, USMS, Assistant Professor, B.S.E., M.S.E., Ph.D.

Hubert, Charles I., Professor, B.E.E., M.S.E.E. (Professional Engineer License, New York)

Kim, Chin-Bea, Lieutenant Commander, USMS, Associate Professor, B.S., M.S., Ph.D.

Kingsley, George, Lieutenant Commander, USMS, Assistant Professor (Marine License: Chief Engineer)

Kirby, Howard M., Commander, USMS, Associate Professor, B.S., M.A.

Madden, Robert T., Lieutenant Commander, USMS, Assistant Professor, B.S., M.S.M.E. (Marine License: Chief Engineer, Steam; Chief Engineer, Diesel)

Malinoski, Leon, Lieutenant (jg), USMS, Laboratory Instructor

Maroney, Nicholas, Lieutenant (jg), USMS, Laboratory Instructor

McDonald, Wallace H., Assistant Professor, B.S., M.S.

Panuska, Robert C., Lieutenant Commander, USMS, Associate Professor, A.B., M.S.

Paquette, Donald R., Associate Professor of Engineering, B.S., M.S. (Marine License: Third Engineer, Steam and Motor; Professional Engineer License, New York)

Randell, John A., Lieutenant Commander, USCG, Assistant Professor, B.S.

Reynolds, Francis X., Lieutenant Commander, USMS, Associate Professor, B.S., B.S.M.E., M.S.M.E. (Marine License: Second Engineer, Steam; Third Engineer, Diesel; Professional Engineer License, New York)

Schuler, Frank X., Commander, USMS, Associate Professor, B.S. (Marine License: Second Engineer)

Sferazo, Louis J., Lieutenant (jg), USMS, Laboratory Instructor (Certified Welder)

Wells, Robert B., Commander, USMS, Associate Professor, B.S. (Marine License: Chief Engineer, Diesel; Third Engineer, Steam)

DEPARTMENT OF MARITIME LAW AND ECONOMICS

Hershey, Robert, Lieutenant Commander, USMS, Associate Professor of Management and Psychology, B.S., M.S., Ph.D. (Certified Psychologist, State of New York)

Jarett, Lawrence, Captain, USMS, Professor of Law, Head of Department, B.S., LL.B., M.A., LL.M., J.S.D. (Member, Bar of the State of New York and Bar of the Supreme Court of the United States)

Katz, Harold, Lieutenant Commander, USMS, Associate Professor of Economics, B.A., M.A., Ph.D.

Kirschen, Sigmund, Commander, USMS, Associate Professor of Economics, B.S.S., M.S.E.

Mahoney, Justin Dennis, Commander, USMS, Associate Professor of Marine Insurance, B.S., M.A.

Moore, William W., Commander, USMS, Associate Professor of Economics, Assistant Head of Department, B.A., M.I.A.

Peck, Jeffrey C., Assistant Professor of Law, B.S., J.D., LL.M. (Member, Bar of the State of New York)

Schwimmer, Martin, Jay, Lieutenant Commander, USMS, Associate Professor of Management, B.B.A., M.B.A., Ph.D.

To obtain further information, address inquiries to:

Commander Emmanuel Jenkins, USMS
Director of Admissions
United States Merchant Marine Academy
Kings Point, New York 11024

UNITED STATES NAVAL ACADEMY
Annapolis, Maryland 21402

The location of the Naval Academy, at the mouth of the Severn River on the Chesapeake Bay, is ideal for the conduct of field studies in oceanography, ocean systems engineering and meteorology. An 81-foot, 71-ton research vessel, supported by a pier-side laboratory facility, is available for group or individual instruction and research. The vessel is fully instrumented for oceanographic and bathymetric data collection, including among its equipment an automatic precision positioning system, an automatic salinity/temperature/depth/sound velocity sensor-recorder, and a precision hydrographic echo sounder.

Laboratory and computer utilization play a dominant role in the programs. Computer equipment available includes a Honeywell 6060, a PDP 1576-1540 hybrid computer and several PDP 8, 11 and 15s. A wide variety of modern laboratory equipment is provided, including a subcritical nuclear reactor, an oceanographic wave tank, an 85-foot towing tank with wave generating and on-line data acquisition and analysis capability, automatic chemical analysis equipment, marine aquaria, a semi-automatic weather station, a complete geology laboratory, and a wide variety of oceanographic and meteorological instruments. Among the expanded laboratory facilities to be provided in the new engineering complex are a 380-foot and 120-foot towing tank (both with random wave generators, on-line data acquisition and analysis capabilities), a coastal engineering basin, a large hyperbaric deep-ocean simulation facility, and a greatly expanded aquarium system for biological oceanographic studies.

The Naval Academy's purpose is to educate midshipmen in preparation for commissioning as career naval officers. Accordingly, midshipmen receive more than 30 semester hours of professional education in the fields of seamanship, tactics, navigation, weaponry, history, law and leadership. Additionally, midshipmen receive a broad liberal arts education in social science and humanities. These studies supplement the normal course of study in an engineering or environmental major and provide a sound foundation for professional development as a naval officer.

The degrees offered are a B.S. in Marine Engineering (41), a B.S. in Naval Architecture (21), a B.S. in Ocean Engineering (30), and a B.S. with a designated major in Oceanography (69). (Figures in parentheses are the numbers of degrees awarded in 1978-1979).

The marine engineering program places major emphasis on the principles of energy conversion and marine propulsion systems design and analysis for both nuclear and fossil fuel plants. Each student is required to complete at least 30 semester hours of courses in the field of marine engineering.

The naval architecture program encompasses a comprehensive analysis and design of vehicles that operate on, under or just above the air-sea interface. The curriculum covers the static and dynamic analyses of ships, both theoretically and experimentally, as well as basic design techniques. There are required 30 hours of courses in the field of naval architecture.

The ocean engineering program provides the student with a fundamental introduction to the application of engineering in the undersea environment, with particular emphasis on structures, materials, wave mechanics, power, acoustics and life-support systems. At least 31 semester hours are required in the field of ocean engineering.

The oceanography program is primarily oriented toward achievement in the areas of physical oceanography and meteorology. Majors in oceanography must complete courses in mathematics through differential equations, chemistry, physics, biology, geology, naval engineering, fluid physics, and fluid dynamics. The basic course sequence within the major includes general meteorology, general oceanography, and environmental dynamics. Additionally, a midshipman must complete three elective courses from within those offered in the department or from course offerings acceptable to the department chairman, given in the mathematics, physics, chemistry or engineering departments. A total of 34 semester hours are required in the major subjects.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF NAVAL SYSTEMS ENGINEERING

EN-200	Naval Engineering I	4
EN-201	Engineering Design Graphics	1
EN-241	Introduction to Naval Systems Engineering	3
EN-300	Naval Engineering II	4
EN-351	Ship Hydrostatis	4
EN-352	Resistance and Propulsion	3
EN-356	Ship Structure	3
EN-361	Marine Power System	3
EN-362	Reactor Physics	3
EN-382	Ocean Materials Science and Engineering	4
EN-410	Seafloor Mechanics	3
EN-420	Coastal Engineering	3
EN-441	Ocean Engineering Structure	3
EN-453	Seakeeping and Manuevering	3
EN-454	Ship Vibrations	3
EN-456	Computer Applications	3
EN-457	Hydrofoil and Propeller Theory	3
EN-458	Advanced Marine Vehicles	3
EN-459	Experimental Naval Architecture	3
EN-460	Ocean Systems Engineering Design	3
EN-463	Reactor Physics II	3
EN-464	Reactor Control Analysis	3
EN-465	Advanced Marine Power Systems	3
EN-468	Nuclear Energy Conversion	3
EN-470	Life Support Systems	3
EN-473	Ocean Engineering Mechanics	3
EN-474	Ocean Energy Conversion	3
EN-477	Undersea Power Systems	3
EN-478	Seminar in Ocean Systems Engineering	1
EN-49x	Naval Engineering Research Design or Construction Project	1-3

DEPARTMENT OF PHYSICS

SP-301	Modern Physics	3
SP-328	Fluid Physics	3
SP-411	Underwater Acoustics and Sonar	3

DEPARTMENT OF OCEANOGRAPHY

SO-313	General Oceanography	4

SO-221	Introduction to Oceanography	3
SO-241	General Meteorology	3
SO-261	Physical Geology	4
SO-412	Environmental Instruments	3
SO-413	Oceanic and Atmospheric Processes	3
SO-415	Environmental Pollution	3
SO-424	Ocean Waves and Tides	3
SO-422	Nearshore Oceanography	3
SO-441	Synoptic Meteorology	3
SO-442	Tropical Meteorology	3
SO-444	Climatology	3
SO-451	Biological Oceanography	3
SO-461	Geological Oceanography	3
SO-471	Chemical Oceanography	3
SO-491, 492	Oceanography Research Project	1
SO-493, 494	Oceanography Research Project	2
SO-495, 496	Oceanography Research Project	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF NAVAL SYSTEMS ENGINEERING

Allen, Kristen L., M.S., Lieut., USN
Allen, Robert R., M.S.M.E., Lieut. Commander, USN
Barr, William A., M.S.M.E., Associate Professor
Bhattacharyya, Rameswar, Ph.D., Associate Professor
Billow, Leon M., M.Ed., Assistant Professor
Bock, Arthur E., M.S., Professor
Burns, Robert L., M.S.M.E., Lieut. Commander, USN
Calisal, Sander, Ph.D., Assistant Professor
Compton, Roger H., Ph.D., Associate Professor
Davis, Dudley L., M.S.A., Lieut., USN
Dawson, Thomas H., Ph.D., Assistant Professor
Eckley, Wayne F., M.S., Associate Professor Emeritus
Fusch, Kenneth E., M.S.C.E., Lieut. Commander, USN
Gibson, Ethen J., M.S., Lieut. Commander, USN
Griffiths, Gary A., B.S., Lieut., USN
Harris, William R., M.S., Lieut. Commander, USN
Hillman, Leo C., B.E., Lieut., USN
Huckenpoehler, William B., Jr., M.N.E., Assistant Professor
Johnson, Bruce, Ph.D., Professor
Kelley, Thomas J., M.S., Commander, USN
Kelly, William H., D.P.E., Lieut. Commander, Royal Navy
Latham, Robert F., M.A., Associate Professor
Lowrie, Samuel A., M.S.M.E., Lieut. Commander, Canadian Navy
McCormick, Michael E., Ph.D., Professor
McGraw, William L., B.S., Lieut., USN
Monney, Neil T., Ph.D., Associate Professor
Nehrling, Bruce C., Ph.D., Assistant Professor
Nelson, Martin E., Ph.D., Assistant Professor
Rankin, Bruce H., Ph.D., Professor
Richard, Clyde C., Ph.D., Assistant Professor
Rockwell, Donald E., B.S., Lieut., USN
Ruys, Ronald E., M.S., Lieut. Commander, USN
Sarich, Ace I., M.S.M.E., Lieut. Commander, USN
Schmermund, William H., B.S., Lieut., USN
Schmidt, Henry, M.S., Lieut. Commander, USN
Schulden, William H., M.N.E., Assistant Professor
Sheldrick, Ralph C., M.S.M.E., Lieut. Commander, USN
St. Denis, Manley, Ph.D., NavSea Research Professor
Wallfred, James G., B.S., Lieut., USN
Wiggins, Peter F., Ph.D., Chairman and Professor
Williams, Pharis E., M.S., Lieut., USN

DEPARTMENT OF OCEANOGRAPHY

Anawalt, Richard A., M.S., Commander, USN
Edsall, Douglas W., Ph.D., Associate Professor
Foerster, John W., Ph.D., Assistant Professor
Hoffman, John F., Ph.D., Associate Chairman and Professor
LaDouce, Ralph J., M.S., Lieut. Commander, USN
McMillan, John G., M.S., Chairman and Commander, USN
Soluri, Elroy A., M.S., Lieut. Commander, USN
Spigai, Joseph J., Ph.D., Commander, USN
Trumbower, Glenn C., M.S., Lieut. Commander, USN
Williams, Jerome, M.A., Professor

To obtain further information, address inquiries to:

Dean of Admissions
United States Naval Academy
Annapolis, Maryland 21402

THE UNIVERSITY OF ALABAMA
University, Alabama 35486

The University of Alabama Marine Science Program is a component of the Marine Environmental Sciences Consortium (Alabama). Laboratories, instructional facilities, faculty offices and the Office of the Director are located at the Dauphin Island Sea Lab. The marine science program operates the Point aux Pins marsh lab on a 250-acre natural marsh, and the 65-foot diesel powered R/V GA Rounsefell.

An undergraduate, interdisciplinary, double major program in Marine Science is available at The University of Alabama. Program components include: general academic requirements, a single department major in biology, chemistry, or geology, and an interdisciplinary major composed of Marine Science and related courses. Students must plan to spend a portion of their academic studies in residence at the Dauphin Island Sea Lab in order to complete Marine Science course requirements. For additional information contact: Marine Science, P. O. Box 2906, University, Alabama 35486.

A Master's degree in Marine Science (Biology) is offered through the Department of Biology's Aquatic Biology Program.

The following courses are offered at the Dauphin Island Sea Lab:

UNDERGRADUATE (Summer only)

MS 304	Marine Geology	4
MS 306	Marine Biology	4
MS 400	Recent Marine Sedimentation	4
MS 403	Coastal Climatology	2

UNDERGRADUATE/GRADUATE (Summer only)

MS 402/502	Marine Vertebrate Zoology	4
MS 407/507	Marine Botany	4
MS 411/511	Marsh Ecology	4
MS 412/512	Marine Ecology	4
MS 413-414/ 513-514	Marine Invertebrate Zoology	4, 4
MS 415/515	Coastal Ornithology	4
MS 417-418/ 517-518	Marine Technical Methods	2, 2
MS 428/528	Introduction to Oceanography	4
MS 431/531	Coastal and Environmental Law	2
Ms 430/530	Research on Special Topics	2-6
MS 450/550	Seminar	1

GRADUATE COURSES (Academic year)

MS 508	Estuarine Science	4
MS 516	Physiology of Marine Organisms	4
MS 538	Marine Zoogeography	4
MS 539	Oceanology of the Gulf of Mexico	4
MS 541	Benthic Community Structure	4
MS 542	Scientific Data Management	2

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGY (Dauphin Island)

Hopkins, Thomas S., Scripps Institution of Oceanography, Professor

Ivester, M. Susan, Ph.D., University of South Carolina, Assistant Professor

Schroeder, William W., Ph.D., Texas A&M University, Associate Professor

AQUATIC BIOLOGY

Boschung, Herbert T., Ph.D., The University of Alabama, Professor

Darden, William H., Jr., Ph.D., Indiana University, Professor and Chairman

Deason, Temd R., Ph.D., University of Texas, Professor

Gabrielson, Frederick C., Jr., Ph.D., University of Georgia, Assistant Professor

Haynes, Robert R., Ph.D., Ohio State University, Assistant Professor

O'Kelley, Joseph C., Ph.D., Iowa State University, Research Professor

Scheiring, Joseph F., Ph.D., University of Kansas, Assistant Professor and Director, Aquatic Biology Program.

Ultsch, Gordon R., Ph.D., University of Florida, Associate Professor

To obtain further information, address inquiries to:

Chairperson, Department of Biology
The University of Alabama
P. O. Box 1927
University, Alabama 35486

or,

Coordinator of Graduate Studies
Dauphin Island Sea Lab
P. O. Box 386
Dauphin Island, Alabama 36528

UNIVERSITY OF ALASKA
Fairbanks, Alaska 99701

Education in the marine sciences is offered through the Marine Science and Ocean Engineering Program in cooperation with the Institute of Marine Science.

The Institute occupies large areas of two buildings in the research complex of the Fairbanks campus. On three floors of one building, custom built in 1974, are located the principle inorganic and organic chemical and biological laboratories and the Institute library. The Resources Building houses the administrative offices and physical, geological, and additional radiochemical, chemical, and benthic biological laboratories. Facilities for biochemistry and marine mammal research are located separately. A full range of modern research equipment is maintained for student and faculty research. Support facilities in Fairbanks include publications and drafting departments, and glass and electronics shops. Marine facilities are located on the coast at Seward. This is the home port of the 95-foot R/V Acona and full staging and support shop facilities are maintained together with the necessary administrative offices. This field station also includes two new laboratory buildings with running seawater facilities and there is an active permanent biological research group in addition to temporary relocations from Fairbanks. Various other small field stations around the state are utilized as needed.

The Program offers M.S. degrees in biological, chemical, fisheries, geological, and physical oceanography, in marine biology and ocean engineering, and Ph.D. degrees in oceanography. All M.S. degrees require a minimum of 30 graduate credits including thesis. Depending on discipline, students are required to take certain combinations of graduate core courses, and shipboard experience is mandatory. Formal training for the Ph.D. degree is tailored to the individual needs by each graduate advisory committee, and candidates are frequently sent to other institutions for specialized courses. The mean populatin is about 40 graduate students and about two Ph.D. degrees are conferred annually.

The following courses are offered:

OCN 111	The Oceans	3
OCN 411	General Oceanography	3
OCN 620	Physical Oceanography	4
OCN 630	Geological Oceanography	3
OCN 640	Fisheries Oceanography	3
OCN 650	Biological Oceanography	3
OCN 660	Chemical Oceanography	3
OCE 670	Ocean Engineering	3
MBI 610	Marine Biology	3
OCN 693	Special Topics	Arranged
OCN 691	Seminar	Arranged
OCN 697	Individual Study	Arranged
OCN 699	Thesis	Arranged

The instructional staff for the courses listed above consists of the following:

Alexander, Vera, Ph.D., Professor of Marine Science, Director, Institute of Marine Science (Limnology and biological Oceanography)

Barsdate, Robert J., Ph.D., Professor of Marine Science (Limnology and Geochemistry)
Burrell, David C., Ph.D., Professor of Marine Science (Geochemistry)
Button, Don K., Ph.D., Professor of Marine Science (Biochemistry)
Colonell, Joseph M., Ph.D., Professor of Marine Science (Ocean Engineering)
Cooney, Robert T., Ph.D., Associate Professor of Marine Science (Biological Oceanography)
Elsner, Robert, Ph.D., Professor of Marine Science (Physiological Ecology)
Fay, Francis H., Ph.D., Associate Professor of Marine Science (Physiological Ecology)
Feder, Howard M., Ph.D., Professor of Marine Science and Zoology (Biological Oceanography, Marine Biology)
Geist, Charles R., Ph.D., Assistant Professor of Physiology and Marine Science (Statistics)
Goering, John J., Ph.D., Professor of Marine Science (Biological Oceanography)
Hood, Donald W., Ph.D., Professor Emeritus of Marine Science (Chemical Oceanography)
Kelley, John J., Ph.D., Associate Professor of Marine Science, Scientific Director, Naval Arctic Research Laboratory (Chemical Oceanography)
Matthews, J. Brian, Ph.D., Associate Professor of Marine Science (Geophysics)
McRoy, C. Peter, Ph.D., Professor of Marine Science (Biological Oceanography)
Mueller, George J., Curator of Aquatic Collections
Naidu, S.A., Ph.D., Assistant Professor of Marine Science (Sedimentology and Geochemistry)
Nevé, Richard, Ph.D., Professor of Marine Science (Biological Oceanography)
Niebauer, Henry J., Ph.D., Assistant Professor of Marine Science (Physical Oceanography)
Nishiyama, Tsuneo, Ph.D., Assistant Professor of Marine Science (Fisheries Oceanography)
Reeburgh, William S., Ph.D., Professor of Marine Science (Chemical Oceanography)
Reichardt, Paul B., Ph.D., Associate Professor of Chemistry (Organic Chemistry)
Rosenberg, Donald H., M.S., Associate Professor of Marine Science, Director, Sea Grant Program (Physical Oceanography)
Royer, Thomas C., Ph.D., Associate Professor of Marine Science (Physical Oceanography)
Sharma, G.D., Ph.D., Professor of Marine Science (Geological Oceanography)
Shaw, David G., Ph.D., Associate Professor of Marine Science (Organic Chemistry)

To obtain further information, address inquiries to:

Head, MSOE Program
Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701

UNIVERSITY OF ARIZONA
Tucson, Arizona 85721

The University of Arizona Marine Sciences Program functions as a teaching, research and advisory unit within the Department of Ecology and Evolutionary Biology of the College of Liberal Arts. It chief academic functions are to aid undergraduates in preparing for graduate studies in the marine biological sciences, and to provide faculty and graduate students with the means to conduct advanced research in marine ecology in the nearby Gulf of California.

The Marine Sciences Program, begun informally in 1958, was officially established in 1965 with the construction of a small marine biology laboratory at Puerto Penasco, Sonora, Mexico, and a grant from the Office of Naval Research for a visiting investigator program. Since then laboratory facilities have expanded at Puerto Penasco, largely due to the Environmental Research Laboratory's programs in desalination, horticulture and shrimp mariculture in cooperation with the Universidad de Sonora, Hermosilla, Sonora. The Puerto Penasco Marine Biological Station is part of a complex of facilities maintained by the UA Environmental Research Laboratory. This includes an extensive sea water system which uses naturally filtered water from beach wells which flows at a constant temperature of about 25° C ± 2° C. The marine station has a wet and a dry lab as well as a beach house used as a dormitory-classroom for visitors. In addition, the UA Marine Sciences Program operates the *R/V La Sirena*, a 31-foot converted trawler for shallow water oceanography and scuba.

The following degrees are offered:

1. *M.S. in Ecology and Evolutionary Biology*. Department of Ecology and Evolutionary Biology. Intended candidates for the M.S. must present a minimum of about 3[illegible] hours of undergraduate preparation in biological sciences equivalent to the requirements for an undergraduate major in this department. They should have completed at least one year of chemistry (inorganic), mathematics, through calculus, and a year of physics. Deficiencies in undergraduate preparation must be made up. An official record of the student's performance in the Graduate Record Examination (Aptitude and Advanced Test in Biology), a full transcript of undergraduate coursework, and three letters of recommendation are required of all applicants. The student must complete 30 graduate credit units in an approved graduate study program. Both thesis and non-thesis M.S. programs are available.

2. *Ph.D. in Ecology and Evolutionary Biology*. Intended candidates for the Ph.D. must present undergraduate coursework as for the M.S. degree. GRE scores, transcripts, and letters of recommendation as described for the M.S. degree are required of all applicants. In addition to the major, a suitable minor area must be selected, and the student must complete an approved, individually-planned graduate study program including coursework in the minor field. An approved dissertation problem is required of all students, and each must pass qualifying, preliminary and final oral examinations, and demonstrate achieved proficiency in one foreign language.

The following courses are related to the marine sciences program:

DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY

150	Fundamentals of Marine Biology	2
440	Oceanography	2
440L	Oceanography Laboratory	2
441	Limnology	4
442	Marine Ecology	5
468	Environmental Pysiology	4
476	Marine Algae	3
480	Invertebrate Zoology	4
482	Ichthyology	4
487	Animal Behavior	2
499	Special Problems	1-5
535	Tropical Ecology	2
540	Advanced Studies in Marine Biology	2

DEPARTMENT OF GEOSCIENCES

570	Introduction to Paleoecology	3

HYDROLOGY AND WATER RESOURCES PROGRAM

Physical Oceanology and Limnology for Hydrologists	2

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY

Calder, William A., Ph.D., Professor
Hendrickson, John R., Ph.D., Professor
Hoshaw, Robert W., Ph.D., Professor
Kodric-Brown, Astrid, Ph.D., Assistant Professor
Miller, Walter B., Ph.D., Professor and Curator of Invertebrates (Dept. of General Biology)
Thomson, Donald A., Ph.D., Professor and Curator of Fishes

DEPARTMENT OF GEOSCIENCES

Flessa, Karl W., Ph.D., Assistant Professor
Schreiber, Joseph F., Jr., Ph.D., Professor

DEPARTMENT OF HYDROLOGY AND WATER RESOURCES

Simpson, Eugene S., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. D.A. Thomson, Chairman
Marine Sciences Program
Department of Ecology and Evolutionary Biology
The University of Arizona
Tucson, Arizona 85721

To obtain information about the shrimp mariculture program at Puerto Penasco write to:

Mr. Carl N. Hodges, Director
Environmental Research Laboratory
Tucson International Airport
Tucson, Arizona 85706

UNIVERSITY OF BRITISH COLUMBIA
Vancouver, B.C., Canada V6T IW5

The Department of Oceanography is a part of the Faculty of Science of the University of British Columbia and provides facilities for work toward the Master of Science and Doctor of Philosophy degrees in the marine aspects of the basic sciences. Offices and laboratories are on the university campus at Point Grey about six miles west of the centre of Vancouver. Field work is carried out on research vessels made available by federal government agencies from the 60-meter C.S.S. Vector to the 77-meter C.N.A.V. Endeavour. Facilities are available for work in botany, chemistry, geology, geophysics, mathematics, physics and zoology. The present research emphases are on coastal and fjord estuary studies, air/sea interaction, structure of the continental shelf and slope, primary and secondary production and low level pollution studies. The department has a PDP-12 computer and the university has an Amdahl V6-11.

The following degrees are offered:

1. M.Sc. in botany, chemistry, geology, geophysics or zoology.

   a) Entrance requirement is an honours B.Sc. in the appropriate field.
   b) Fifteen units of credit including six for thesis research (one unit of credit is given for a 25-hour lecture course).
   c) Comprehensive examination.
   d) Research and thesis.
   e) Language requirement - reading knowledge of one foreign language if required by supervising committee.

2. Ph.D. in botany, chemistry, geology, geophysics or zoology.

   a) Entrance requirement is a master's degree or a bachelor's degree with first class honours standing, or a successful first graduate year in a master's program with clear evidence of research ability.
   b) Courses as required by supervising committee (minimum of 15 units if directly from B.Sc. degree including first class average for nine units minimum in first year).
   c) Comprehensive examination.
   d) Original research and presentation of thesis.
   e) Language requirement as determined by supervising committee.
   f) Public examination and defense of thesis.

Programs are being prepared for joint B.Sc. degrees in a basic science plus oceanography courses.

Although there is no formal program in ocean engineering yet, some graduate students in civil, electrical and mechanical engineering are proceeding on marine oriented M.A.Sc. and Ph.D. programs in the Faculty of Applied Science in conjunction with the Department of Oceanography.

There were six M.Sc. and three Ph.D.'s awarded in 1977 and six M.Sc. and eight Ph.D.'s awarded in 1978.

The following courses are offered:

UNDERGRADUATE COURSES

OCEANOGRAPHY

310	Man and the Oceans	1
400	Introduction to Synoptic Oceanography	1
401	Introduction to Dynamic Oceanography	1
402	Introduction to Chemical Oceanography	1
403	Introduction to Biological Oceanography	1
404	Introduction to Geological Oceanography	1
406	Aquatic Ecology II	1.5

GRADUATE COURSES

OCEANOGRAPHY

501	Advanced Synoptic Oceanography	1
502	Advanced Chemical Oceanography	1
503	Oceanographic Methods	1
504	Organic Chemicals in the Marine Environment	1
505	Special Advanced Courses	1-3
506	Marine Phytoplankton	1
507	Zooplankton Ecology	1
508	Air-Sea Transfer Processes	1
509	Biological Oceanographic Mechanisms	1
510	Seminar in Dynamic Oceanography	1

BOTANY

510	Advanced Marine Phycology	3
512	Practical Marine Phytoplankton Study	2

GEOLOGY

426	Marine Geology	1.5
506	Marine Geology and Sedimentology	3
520	Problems in Sedimentology	1.5

PHYSICS

537	Dynamic Oceanography	2
539	Waves and Tides	2
540	Turbulence	2
421	Introductory Meteorology	1
541	Dynamic Meteorology	1
542	Waves in Rotating Fluids	1

(The figures to the right of the column indicate the unit value of the course. One unit represents one lecture per week for the winter session of 25 weeks, or the equivalent.)

The instructional staff in the Department includes:

BOTANY

Harrison, P.J., Ph.D., Assistant Professor
Taylor, F.J.R., Ph.D., Professor

CHEMISTRY

Andersen, R.J., Ph.D., Assistant Professor
Grill, E.V., Ph.D., Assistant Professor

GEOLOGY

Calvert, S.E., Ph.D., Professor
Chase, R.L., Ph.D., Professor
Murray, J.W., Ph.D., Professor

GEOPHYSICS

Clowes, R.M., Ph.D., Associate Professor

MATHEMATICS

Mysak, L.A., Ph.D., Professor

PHYSICS

Burling, R.J., Ph.D., Professor
Emery, W.J., Ph.D., Assistant Professor
LeBlond, P.H., Ph.D., Professor
Osborn, T.R., Ph.D., Associate Professor
Pond, G.S., Ph.D., Professor

ZOOLOGY

Lewis, A.G., Ph.D., Professor
Parsons, T.R., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. S.E. Calvert, Head
Department of Oceanography
The University of British Columbia
Vancouver, B.C., Canada V6T 1W5

UNIVERSITY OF CALIFORNIA

Instruction in marine-related topics is available on all interdepartmental UC campuses. Degree programs in the marine sciences or programs with marine specialization are offered at Berkeley (B.S. in Marine Biology and Masters and Doctoral programs in Ocean Engineering), Davis (B.S. in Wildlife and Fisheries Biology), Irvine (M.S. and Ph.D. programs in Developmental and Cellular Biology or in Ecology and Evolutionary Biology with marine specialization), Santa Barbara (B.A. in Aquatic Biology), and San Diego (graduate instruction leading to M.S. and Ph.D. in Oceanography, Marine Biology and Earth Sciences at Scripps Institution of Oceanography). Institutions, at which no specific marine programs are offered but at which coursework and independent study in marine sciences are possible, are Irvine (B.S. in Biology), Santa Barbara (M.A. and Ph.D. in Biology), and Santa Cruz (B.A. in Environmental Studies).

Since course credits are transferable by consent, all UC campuses offering marine-related instruction are listed. In addition to the campuses listed above, University of California entries are Bodega Marine Lab, Los Angeles and Riverside are included.

Note: A comprehensive listing of marine programs in California (which includes those of the schools listed above) -- Directory of California Marine Science Programs, by Kelly Elizabeth Anderson, Environmental Studies Program, University of California, Santa Cruz -- will be published in fall 1979. Sponsored by NOAA, Office of Sea Grant, and the California State Resources Agency, this new directory will include 11 two-year colleges and 40 four-year universities or colleges offering programs in marine sciences.

UNIVERSITY OF CALIFORNIA, BERKELEY
Berkeley, California 94720

UC Berkeley offers marine-related programs in the biological sciences and in engineering. In the life sciences, instruction and research are shared between the Berkeley campus and the Bodega Marine Laboratory (BML).

BIOLOGY WITH MARINE SPECIALIZATION

University of California, Berkeley offers a Bachelor of Science degree program in Biology with specialization in Marine Biology. The program is billed as a field major, and it serves the needs of students who want a broader training in the biological sciences than is possible in a departmental major. Students enrolled in the program take courses from several fields, including biology, zoology, botany, genetics, chemistry, mathematics, physics, and molecular biology. They must complete a one-quarter course or summer course at a marine laboratory, and at least one course in statistics is strongly advised. To complete the program, students must have at least 45 units of upper division work in the major.

Facilities in the biological sciences include a 500 gallon recirculating seawater system, and a number of small craft for subtidal research maintained by the Zoology Department. The University Herbarium houses one of the largest collections of marine algae in the United States. The Naval Biomedical Research Laboratory, a unit attached to the School of Public Health, has facilities for research on environmental biology and other topics of interest to the U.S. Navy. There is also a research diving program which trains and provides support to faculty and students performing scientific work underwater using scuba.

Research in the marine biology field is conducted at the Richmond Field Station and the Bodega Marine Laboratory. Oceanographic research vessels and ship time are available locally through arrangements with the California Maritime Academy and other local sources. In San Diego, research is conducted through the University's marine facilities at the Scripps Institution of Oceanography.

To obtain further information, address inquiries to:

Dr. John West
Department of Botany
University of California, Berkeley
Berkeley, California 94720
(415) 642-1487

OCEAN ENGINEERING

The University of California, Berkeley offers several graduate level degree programs in Ocean Engineering: M.S., M.E., Doctor of Engineering, and Doctor of Philosophy in Engineering.

The Ocean Engineering program is interdisciplinary; it incorporates a wide range of engineering disciplines, including civil engineering, materials science, and mineral engineering, mechanical engineering, and naval architecture.

Graduate students in the ocean engineering program study a multitude of marine-related engineering programs, such as air-sea interactions, coastal engineering, corrosion in sea water, desalination, marine and offshore construction, harbor design, marine geophysics, waste disposal, engineering properties of marine sediments, ocean mining and prospecting, oceanographic data analyses, marine sediment transport, ocean energy, oceanographic instrumentation, offshore platforms and pipelines, marine and estuarine pollution control, oceanographic vehicles, and properties of engineering materials in sea water.

Research is conducted chiefly in the various laboratories in the Berkeley campus and at the Richmond Field Station, Bodega Marine Laboratory, and Scripps Institution of Oceanography. Oceanographic research vessels and ship time are available locally through working arrangements with the California Maritime Academy and other sources, and in San Diego for worldwide operations through the University's marine facilities at the Scripps Institution of Oceanography.

To obtain further information, address inquiries to:

Dan C. Gerwick
Professor of Civil Engineering
217 McLaughlin Hall
University of California, Berkeley
Berkeley, California 94720
(415) 642-5672

or,

W.C. Webster
Professor of Naval Architecture
210 Naval Architecture Building
University of California, Berkeley
Berkeley, California 94720
(415) 642-5464

UNIVERSITY OF CALIFORNIA
BODEGA MARINE LABORATORY
Bodega Bay, California 94923

The Bodega Marine Laboratory (BML) is a research and teaching facility of the University of California which provides support for degree programs offered by the academic departments of the Berkeley and Davis campuses. Undergraduate and graduate courses are offered at BML and graduate students are in full-time residence conducting thesis research. Admission of students to the degree programs is controlled by the academic departments and Graduate Divisions of the university campuses.

The laboratory is situated on a 326-acre biological refuge located on the outer coast of Bodega Head; the property includes more than a mile of rocky shoreline, short stretches of sandy beach, and mixed mud and sand flats in Bodega Harbor. The main laboratory building houses 25 modern research laboratories and two teaching laboratories. A newer Aquaculture Facility contains additional research laboratories devoted to a variety of projects investigating aspects of crustacean aquaculture. Equipment and facilities are available for work in biochemistry, physiology, developmental biology, aquaculture, microbiology, ecology, botany, zoology and marine geology. Most individual laboratories and classrooms are provided with running filtered seawater and seawater tables for experiments and for holding animals. Additional larger tanks and seawater facilities are available in special aquarium rooms. Inboard and outboard powered vessels are available to support shallow water coastal research as well as harbor and estuary work.

The degrees of Master of Arts and Doctor of Philosophy in botany, zoology, geology, endocrinology, nutrition, pathology and genetics are offered by the graduate division of the Berkeley and Davis campuses for research conducted at the Bodega Marine Laboratory.

Degrees granted in 1978-1979: One Ph.D. in Physiology; four Ph.D.'s in Zoology; one Ph.D. in Geology; and one Ph.D. in Electrical Engineering.

The following courses are offered at BML in conjunction with the degree programs:

UNDERGRADUATE COURSES

Summer

Botany 104	Marine Botany	10
Geology 119	Marine Paleoecology	9
Zoology 157	Biology of Marine Invertebrates	10

Spring

Interdepartmental Studies 100	Problems in Marine Biology	15

Autumn

Animal Science 119	Theory and Practice of Aquaculture	15

GRADUATE COURSES

Summer

Geology 219	Special Studies in Marine Geology and Paleoecology	6-9

Winter

Zoology 219	Seminar in Marine Biology	2

The instructional staff for the courses listed above consists of the following:

Bowser, Paul, Ph.D., Assistant Pathologist and Lecturer in Animal Science, University of California, Davis
Chang, Ernest, Ph.D., Assistant Professor and Assistant Endocrinologist, University of California, Davis
Conklin, Douglas, Ph.D., Assistant Nutritionist and Lecturer in Animal Science, University of California, Davis
Farmer, Jack, Ph.D., Lecturer in Geology, University of California, Davis
Hand, Cadet, Ph.D., Professor of Zoology, University of California, Berkeley
Hedgecock, Dennis, Ph.D., Assistant Geneticist and Lecturer in Animal Science, University of California, Davis
Pearse, John, Ph.D., Associate Professor of Biology, University of California, Santa Cruz
Phillips, David, Ph.D., Assistant Professor of Zoology, University of California, Davis
Rokop, Frank, Ph.D., Lecturer, Biology, University of California, San Diego
Smith, Ralph, Ph.D., Professor of Zoology, University of California, Berkeley
Van Veldhuizen, Harvey, Ph.D., Visiting Assistant Professor of Zoology, University of California, Berkeley
West, John, Ph.D., Professor of Botany, University of California, Berkeley

To obtain further information, address inquiries to:

Dr. Cadet Hand, Director
Bodega Marine Laboratory
P. O. Box 247
Bodega Bay, California 94923

UNIVERSITY OF CALIFORNIA, DAVIS
Davis, California 95616

WILDLIFE AND FISHERIES BIOLOGY

University of California, Davis offers a Bachelor of Science degree program in wildlife and fisheries biology. Although the program is not clearly defined as a marine science-oriented program, students must take courses in aquatic entomology, limnology, and oceanography to complete the major.

The major deals with the interface between the needs of man and wildlife in terms of ecological stability, recreation, and food supply. Emphasis is placed on biological and physical sciences, with special emphasis in fisheries. The program provides training in biology appropriate to careers as fisheries biologists, fish technicians, or, after additional academic preparation, for careers in teaching, research, and administration in the fisheries field.

Students in the fisheries biology specialization program take courses from several disciplines, including courses in entomology, environmental studies, mathematics, wildlife and fisheries biology, biology, botany, chemistry, computer sciences, physics, zoology, genetics, and physiology.

Research Facilities

The University of California Institute of Marine Resources is a statewide institute with its headquarters in La Jolla. The part of its activities dealing with the use of the ocean as a source of food is part of the Department of Food Science and Technology at Davis. The staff is concerned with factors affecting the chemical, biochemical, microbiological, and nutritional properties of fish and other seafoods.

The following degrees are offered:

1. B.S. in Wildlife and Fisheries Biology - Fisheries option requirement.

PREPARATORY SUBJECT MATTER	54
Biology (Biological Sciences 1)	5
Botany (Botany 2)	5
Chemistry (Chemistry 1A, 1B, 8A, 8B)	16
Computer Science (Engineering 5A, Animal Science 127, or Mathematics 19)	3
Mathematics (Mathematics 13, 16A, 16B)	1C
Physics (Physics 2A, 2B, 2C)	9
Zoology (Zoology 2-2L)	6

DEPTH SUBJECT MATTER	26-31
Chemistry (Biochemistry 101A-101B or Physiological Sciences 101A-101B)	6-7
Ecology (Environmental Studies 100, Entomology 104, or Zoology 125)	3-4
Genetics (Genetics 120 or 100A-100B)	4-6
Physiology (Physiology 110)	5
Vertebrate Anatomy (Zoology 105 or 106 and 106P)	4-5
Evolution (Zoology 148, 149, Genetics 103, or the equivalent)	3-5

BREADTH SUBJECT MATTER	20
English 1 and Rhetoric 1 or the equivalent (see College requirement)	8
Social Sciences and Humanities	12

COURSES IN THE MAJOR	
Wildlife and Fisheries Biology (Wildlife and Fisheries Biology 122, 130, 140)	11
Aquatic Entomology (Entomology 116)	3
Limnology/Oceanography (Environmental Studies 116, 151, or 150C)	3-4
Statistics (upper division courses with advisor's approval)	7-9
Fisheries Biology (Wildlife and Fisheries Biology 102, 120, 121)	14

UNRESTRICTED ELECTIVES	34-39
TOTAL UNITS FOR THE MAJOR	180

2. M.S. and Ph.D. degrees are available in Ecology and Physiology.

Degrees awarded in past years: 10 B.S.; four M.S.; and two Ph.D.'s.

The following courses are offered in conjunction with the above programs:

10	Wildlife Biology	4
102	Field Studies in Fisheries Biology	6
120	Biology of Fish	4
121	Physiology of Fishes	4
122	Dynamics of Exploited Animal Populations	3
130	Physiological Ecology of Wildlife	5
140	Ecology and Evolution of Vertebrate Social Organization	3
190	Proseminar in Wildlife and Fisheries Biology	1

GRADUATE COURSES

290	Seminar	3
291	Fish Ecology Seminar II	2
298	Group Study I, II, III	1-5
299	Research I, II, III	1-12

The instructional staff for the courses listed above consists of the following:

WILDLIFE AND FISHERIES BIOLOGY

Cech, Joseph J., Jr., Ph.D., Assistant Professor
Moyle, Peter B., Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dennis G. Raveling, Chairperson of the Division
Wildlife and Fisheries Biology Department
Division Office, 66 Briggs Hall
University of California, Davis
Davis, California 95616
(916) 752-6586

GEOLOGY DEPARTMENT

No specific facilities for geological studies are available within the department, however, facilities at Bodega Marine Laboratory are available to our students.

The following degrees are offered:

1. A.B. and B.S. degrees in Geology (specialization in Marine Geology is available)

2. M.S. degree in Geology with Marine Science emphasis; 30 units required, plus thesis.

3. Ph.D. degree in Geology with Marine Science emphasis; dissertation required.

The following courses are offered in conjunction with the above programs:

106	Ancient Environments	3
107	Paleobiology	3
111A	Invertebrate Paleontology	4
111B	Paleobiology of Protista	4
116	The Oceans	3
S119	Marine Geology and Paleobiology	9
126	Sedimentation	4
150A	Physical and Chemical Oceanography	3
150B	Geology of the Oceans	3
150C	Biological Oceanography	3
153	Geomorphology	3
190	Seminar in Geology	1
198	Directed Study	1-5
199	Independent Study	1-5
206	Regional Stratigraphy	3
216	Regional Tectonics	3
S219	Research in Marine Studies	6-9
260	Paleontology	3
263	Functional Analysis of Fossils	4
290	Seminar in Geology	1
298	Group Study	1-5
299	Research in Geology	1-12

The instructional staff for the courses listed above consists of the following:

Bond, Gerard, Ph.D., Assistant Professor
Cowen, Richard, Ph.D., Professor
Higgins, Charles G., Ph.D., Professor
Lipps, Jere H., Ph.D., Professor
Moores, Eldridge M., Ph.D., Professor
Ward, Peter D., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Graduate Advisor
Department of Geology
University of California, Davis
Davis, California 95616

DEPARTMENT OF ZOOLOGY

The following degrees are offered:

1. M.A. in Zoology (five awarded in 1978-1979)

a) Thirty-six credits including credit for thesis research.
b) Successful completion of a First Year Examination in General Zoology.
c) Presentation of a Master's thesis.

2. Ph.D. in Zoology (seven awarded in 1978-1979)

a) There are no course requirements; a First Year Advisory Committee advises each Ph.D. student on the course of study.
b) Successful completion of a First Year Examination in General Zoology.
c) Successful completion of an Oral Qualifying Examination at the beginning of the third year.
d) Presentation of a Ph.D. thesis.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Zoo 100	Embryology	4
Zoo 101	Experimental Analysis of Animal Development	3
Zoo 110	Principles of Environmental Science	4
Zoo 112A-B	Invertebrate Zoology	8
Zoo 116	Principles of Animal Resource Management	5
Zoo 125	Animal Ecology	3
Zoo 138	Ecology of Tropical Latitudes	3
Zoo 142	Invertebrate Physiology	3
Zoo 142L	Invertebrate Physiology Lab	3
Zoo 144	Neuroethology	4
Zoo 155	Behavior of Animals	4
Bio Sci 115	Problems in Marine Biology	15

GRADUATE COURSES

Zoo 201	Advanced Biological Ecology	4
Zoo 203	Global and Regional Modelling	6
Zoo 224	Developmental Biology	3
Zoo 228	Experimental Animal Ecology	3
Zoo 287	Seminar in Behavior	2
Zoo 292	Seminar in Development	2
Zoo 293	Seminar in Invertebrate Zoology	2
Zoo 294	Seminar in Animal Ecology	2
Zoo 295	Seminar in Marine Invertebrate Ecology	2
Zoo 297	Seminar in Systematic Zoology and Evolution	2

The instructional staff for the courses listed above consists of the following:

Armstrong, Peter B., Ph.D., Professor
Crowe, John H., Ph.D., Associate Professor
Mulloney, Brian, Ph.D., Associate Professor
Nuccitelli, Rich, Ph.D., Assistant Professor
Phillips, David W., Ph.D., Assistant Professor
Rudd, Robert L., Ph.D., Professor
Salt, George W., Ph.D., Professor
Toft, Cathy, Ph.D., Assistant Professor
Watt, Kenneth E.F., Ph.D., Professor
Wilson, David, Ph.D., Assistant Professor
Stamps, Judy, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. John H. Crowe
Department of Zoology
University of California, Davis
Davis, California 95616

UNIVERSITY OF CALIFORNIA, IRVINE
Irvine, California 92717

The main campus is at Irvine, located four miles from rocky intertidal and one mile from estuarine shores. Research equipment includes numerous environmental growth chambers, specific ion proves, pH meters, oxygen analyzers, spectrophotometers, microscopes and photographic equipment. The School of Biological Sciences contains four departments (Molecular Biology and Biochemistry, Developmental and Cell Biology, Ecology and Evolutionary Biology, Psychobiology). Undergraduate teaching is organized on a School basis with graduate programs in each department.

The following degrees are offered:

1. B.S. (Biological Sciences) 45 course credits (180 quarter units)

a) Biology	49 quarter units
b) Chemistry	30 quarter units
c) Physics	15 quarter units
d) Mathematics	12 quarter units
e) Humanities	24 quarter units

2. M.S. (Developmental and Cell Biology or Ecology and Evolutionary Biology)

   a) Non-thesis degree with specialization in marine biology (nine upper division or graduate courses, followed by a comprehensive examination)
   b) Thesis degree with specialization in marine biology (seven upper division or graduate courses with presentation of a thesis)

3. Ph.D. (Developmental and Cell Biology or Ecology and Evolutionary Biology)

   a) Nine upper division or graduate courses, followed by a comprehensive examination and presentation of a thesis

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Bio Sci 131	Biology of the Open Oceans	4
Bio Sci 131L	Biology of the Open Oceans Laboratory	1
Bio Sci 169	Marine Ecology	4
Bio Sci 175	Phycology	4
Bio Sci 176	Phytoplankton Biology	4
Bio Sci 176L	Phytoplankton Laboratory	2
Bio Sci 178	Aquatic Productivity	4
Bio Sci 180A, B	Invertebrate Zoology	4
Bio Sci 181	Applied Marine Ecology	6
Bio Sci 182	Applied Marine Productivity	6
Bio Sci 199	Undergraduate Research	1-4

GRADUATE COURSES

E&E 200, D&C 200	Research (Phycology, Phytoplankton Biology, Comparative Physiology, Marine Invertebrate Biology)
D&C 203, E&E 203	Tutorial (Phycology, Phytoplankton Biology, Comparative Physiology, Marine Invertebrate Biology)
E&E 222	Seminar in Phycology
E&E 228	Seminar in Marine Ecology
E&E 278	Productivity Ecology

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY

Brenchley, Gayle, Ph.D., Assistant Professor
Dixon, Peter S., Ph.D., Professor
Littler, Mark M., Ph.D., Associate Professor

DEPARTMENT OF DEVELOPMENTAL AND CELL BIOLOGY

Lenhoff, Howard, Ph.D., Professor
Stephens, Grover C., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. Mark Littler
Associate Professor
Department of Ecology and Evolutionary Biology
University of California, Irvine
Irvine, California 92717

UNIVERSITY OF CALIFORNIA, LOS ANGELES
Los Angeles, California 90024

Although there is no specific degree program at UCLA concerned only with marine science, it is possible to specialize in many aspects of marine science through existing undergraduate and graduate degree programs attached to individual departments and schools. In this way, the considerable faculty and material resources of this large campus are brought to bear on the marine environment, aided by resource-sharing arrangements with neighboring campuses, notably the Scripps Institution of Oceanography of the University of California, San Diego, and other nearby institutions, notably the University of Southern California.

Courses in marine science and related fields are offered through several major departments and schools, notably Biology (Biol), Engineering and Applied Science (EAS), Geography (Geog), Geology (Geol), Kinesiology (Kin), Microbiology and Immunology (MI), and Physiology (Physl). In addition, faculty in several other departments and schools are actively engaged in marine-related research, notably in Architecture and Urban Planning, Law, Management, Nuclear Medicine and Radiation Biology, and the Center for Health Sciences with its many departments.

The following courses are offered through the above-mentioned departments and schools:

UNDERGRADUATE COURSES

Biol 25	The Oceans
Biol 101	Biology of Marine Plants
Biol 102	Biology of Marine Invertebrates
Biol 104	Biology of Marine Vertebrates
Biol 105	Biology of Invertebrates
Biol 106A	Experimental Marine Invertebrate Zoology
Biol 106B	Experimental Marine Invertebrate Zoology
Biol 111	Biology of Vertebrates
Biol 112	Ichthyology
Biol 113	Herpetology
Biol 114	Ornithology
Biol 115	Mammalogy
Biol 119	Principles of Ecology and Evolution
Biol 123	Ecology of Marine Communities
Biol 124	Field Ecology
Biol 199	Special Studies

Geog 102	Geomorphology
Geog 104	Climate and Man
Geog 108	Plant Geography
Geog 112	Animal Geography: Biophysical Aspects
Geog 120	Conservation of Resources: North America
Geog 121	Conservation of Resources: Underdeveloped World

ESS 3	Evolution: Solar System, Earth, Life
ESS 15	Introduction to Oceanography
ESS 115	Principles of Paleontology
ESS 119	Continental Drift and Sea Floor Spreading
ESS M130	Isotope Geochemistry
ESS M131	Geochemistry
ESS 132	Principles of Biogeochemistry
ESS 137	Petroleum Geology
ESS 141	Sedimentology
ESS 144	Marine Geology
ESS 150	Remote Sensing for Earth Sciences

Kin 115	Aquatic Kinesiology

Atom. Sci. 143	Physical Oceanography

GRADUATE COURSES

Biol 203	Marine Botany and Physiology
Biol 205	Marine Invertebrate Biology
Biol 206	Advanced Ichthyology
Biol 213	Community Ecology
Biol 214	Physiological Ecology
Biol 215	Theoretical Ecology
Biol 217	Marine Ecology
Biol 218	Oceanology
Biol 224	Developmental Biology of Marine Organisms
Biol 240	Physiology of Marine Animals
Biol 272	Seminar in Marine Biology

EAS 250A	Foundations of Fluid Dynamics
EAS 250B	Viscous and Turbulent Flows
EAS 251A	Stratified and Rotating Fluids
EAS 251B	Marine Hydrodynamics

Geog 202	Advanced Geomorphology
Geog 203	Seminar: Geomorphology
Geog 204	Advanced Climatology
Geog 205	Seminar: Climatology
Geog 208	Advanced Biogeography: Plants
Geog 212	Advanced Biogeography: Animals
Geog 213	Seminar: Biogeography

ESS 200A	Introduction to Geophysics and Space Physics 1: The Solid Earth and Planets
ESS 200B	Introduction to Geophysics and Space Physics 2: Oceans and Atmospheres
ESS 210	Advanced Paleontology
ESS 212	Paleoecology
ESS 215	Paleobiology of Plant Microorganisms
ESS 216	Micropaleontology
ESS 241	Sedimentary Petrology
ESS 252	Seminar in Geochemistry
ESS 254	Seminar in Sedimentology
ESS 257	Seminar in Paleontology

Kin 210C	Exercise Physiology: Environmental Factors
Kin 221	Underwater Kinesiology

Atom. Sci. 210	Dynamics of Planetary Circulations
Atom. Sci. 218	Dynamics of the Atmosphere-Ocean Systems

MI 254	Seminar in Immunogenetics

The instructional faculty for the courses listed above consists of the following (all personnel hold the degree of Ph.D. or its equivalent):

BIOLOGY

Bartholomew, George A., Professor of Zoology
Chapman, David J., Professor of Biology
Cody, Martin L., Professor of Biology
Edney, Eric B., Professor of Biology
Gordon, Malcolm S., Professor of Biology
Gorman, George C., Associate Professor of Biology
Howell, Thomas R., Professor of Zoology
Morin, James G., Associate Professor of Biology
Muscatine, Leonard, Professor of Biology
Nagy, Kenneth A., Adjunct Associate Professor of Biology
O'Connor, John D., Associate Professor of Cell and Developmental Biology
Vance, Richard R., Assistant Professor of Biology
Walker, Boyd W., Professor of Zoology

ENGINEERING AND APPLIED SCIENCE

Charwat, Andrew, Professor of Engineering and Applied Science
Cole, Julian D., Professor of Engineering and Applied Science and Professor of Mathematics
Crow, Steven C., Associate Professor of Engineering and Applied Science

GEOGRAPHY

Bennett, Charles F., Professor of Biogeography
Orme, Antony R., Professor of Geography
Sauer, Jonathan D., Professor of Geography
Trimble, Stanley W., Assistant Professor of Geography
Walter, Hartmut, Associate Professor of Biogeography
Westman, Walter, Associate Professor of Geography

EARTH AND SPACE SCIENCES

Bird, G. Peter, Assistant Professor of Geophysics and Geology

Busse, Friedrich H., Professor of Geophysical Fluid Dynamics
DeNiro, Michael J., Assistant Professor of Geochemistry
DePaolo, Donald J., Assistant Professor of Geochemistry and Geology
Ernst, W. Gary, Professor of Geology and Geophysics
Hall, Clarence A., Jr., Professor of Geology
Jackson, David D., Associate Professor of Geophysics
Johnson, Bradford K., Lecturer in Geology
Kaplan, Isaac R., Professor of Geochemistry
Loeblich, Helen Tappan, Professor of Paleontology and Geology
Reed, Walter E., Associate Professor of Geology
Sabins, Floyd F., Jr., Lecturer in Geology
Schopf, J. William, Professor of Paleobiology

KINESIOLOGY

Egstrom, Glen H., Professor of Kinesiology (Campus Diving Officer)

ATMOSPHERIC SCIENCES

Edinger, James G., Professor of Atmospheric Sciences
Wurtele, Morton G., Professor of Atmospheric Sciences

MEDICAL MICROBIOLOGY AND IMMUNOLOGY

Hildemann, William H., Professor of Immunology and Immunogenetics

DENTISTRY

Junge, Douglas, Associate Professor of Oral Biology and Physiology

To obtain further information on the above programs, address inquiries to the Chairpersons of the individual departments listed. For general information concerning marine studies at UCLA, address inquiries to:

Planning Office
University of California, Los Angeles
2107 Administration Building
Los Angeles, California 90024

UNIVERSITY OF CALIFORNIA, RIVERSIDE
Riverside, California 92502

The University of California, Riverside is a member of the consortium that operates the Catalina Marine Biological Laboratory. (See listing for the University of Southern California for further information.)

The department of Geological Sciences and the Department of Earth Sciences at Riverside offer the following courses relevant to marine sciences:

Earth Sciences 1	The Earth, Its Fluid Envelope	4
Earth Sciences 3	The Earth, Its History of Life as Revealed in the Rocks	4
Geological Sciences 125	Stratigraphy and Sedimentary Petrology	4
Geological Sciences 130	Introduction to Oceanography	4
Geological Sciences 131	Marine Geology	4

To obtain further information, address inquiries to:

M.O. Woodburne, Chairman
Department of Earth Sciences
University of California, Riverside
Riverside, California 92502

UNIVERSITY OF CALIFORNIA, SANTA BARBARA
Santa Barbara, California 93106

Marine research and teaching facilities are housed in a marine laboratory complex and portions of other departmental buildings. These marine facilities form part of the general university campus -- located at seaside -- and are in close proximity to all other science departments, the library (1,200,000 volumes), and computer center. Marine laboratories in several buildings are provided with excellent seawater service, from a new seawater system, and are suitably equipped for needs in a broad range of biological and other disciplines. Field-oriented work is supported by boats, suitable for work in coastal waters (including those around the Santa Barbara Channel Islands), and by diving and other field equipment. The University operates a field station on Santa Cruz Island, the largest of the northern Channel Islands. The Department of Biological Sciences offers an undergraduate major in Aquatic (marine and freshwater) Biology. Graduate students in Biology may take higher degrees (M.A. or Ph.D.) with an emphasis in Marine Biology. Other research facilities used by University of California, Santa Barbara include vessels operated by the Scripps Institution of Oceanography and the University of Southern California, and facilities at Hopkins Marine Station, Pacific Grove. In addition to the faculty listed below who are directly involved in courses, there are 34 faculty and professional researchers active in marine research.

Degrees offered and their requirements are as follows:

1. The B.A. in Aquatic Biology requires as preparation: 12 units General Chemistry; 10-16 units

Organic Chemistry; 12-15 units Calculus; 12-15 units General Physics; 14 units Introductory Biology. In the junior and senior years students must complete at least 38 units in upper division Biology, Botany, and Zoology, of which 16 fall within specifically required courses.

2. The M.A. in Biology, Botany and Zoology is offered under two plans:

a) Thesis degree with specialization in marine biology requires 30 units and acceptance of thesis.
b) Non-thesis degree with specialization in marine biology requires 36 units and passing of comprehensive examinations.

3. The Ph.D. in Biology specifies no minimum number of units but requires a minimum two-year residence, with at least four units to be undertaken per quarter. Comprehensive examinations must be passed in major and minor fields, and competence must be demonstrated in a modern foreign language.

During the 1977-1978 academic year the Department of Biological Sciences granted 50 B.A. degrees in Aquatic Biology, 16 M.A. degrees emphasizing marine biology and eight Ph.D.'s with marine emphasis.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

BIOLOGICAL SCIENCES

Biology

105	Biology, Neurobiology I	4
106	Biology, Neurobiology II	4
134	Physiology of Algae	2
134L	Physiology of Algae - Laboratory	2
141	Biology of the Marineland Interface	3
142	Marine Microbiology	4
143	Biology of Zooplankton	4
144	Development of Marine Invertebrates	3
145A	Physics and Chemistry of Aquatic Environments	3
145L	Chemical and Physical Methods of Aquatic Environments	2
145B	Biology of Aquatic Systems	2
145BL	Methods of Aquatic Biology	2
145CL	Laboratory in Aquatic Biology	2
146	Marine Ecology	4
147	Biology of Coral Reefs	4
151	Photosynthesis and Primary Production	3
152	Marine Phytoplankton: Biogeography and Productivity	2
153	Deep-sea Biology	3
154	Biological Limnology	3
171	Advanced Phycology	4
176	Systematics, Morphology, Structure, and Evolution of Aquatic Diatoms	1
176L	Laboratory in Aquatic Diatoms	2
194	Group Studies in Phycology	1
194Q	Group Studies in Aquatic Biology	1
194S	Group Studies in Protist Physiology	1
194Z	Group Studies in Ecological Physiology	1

Botany

170	Phycology	4

Zoology

105	Functional Design of Fishes	4
112A	Invertebrate Zoology	5
112B	The Invertebrate as an Experimental Animal	3
112L	Problems in Invertebrate Zoology	3
121	Aquatic Arthropods	2
122	Biology of Aquatic Arthropods	3
123	Diversity of Aquatic Arthropods	2
130	Biology of Amphibians and Reptiles	4
161	Systematics of Fishes	4

GRADUATE COURSES

BIOLOGICAL SCIENCES

Biology

217	Marine Toxins	2
234	Physiology of Algae	2
251	Marine Phytoplankton: Biogeography and Productivity	2
270	Molecular Marine Biology	2
595I	Group Studies in Ecological Physiology	1
595AE	Ichthyology Seminar	1
595CC	Marine Zooplankton	1
595EE	Symbiosis: Concepts and Principles	1
595FF	Photosynthesis	1

Botany

276	Systematics, Morphology, Structure and Evolution of Aquatic Diatoms	1
276L	Laboratory in Aquatic Diatoms	2

UNDERGRADUATE COURSES

Economics

115	Environmental Economics	4
122	Natural Resources Economics	4

ENVIRONMENTAL STUDIES PROGRAM (Undergraduate)

12	The Land and Water Environments	4
109	Natural History of the Santa Barbara Channel	4
110	Marine Mammalogy	4
134	Coastal Environment of North America	4

Geography

110	Introduction to Meteorology	4
119	Climatic Changes	4
162	Environmental Pollution	4
163	The Ocean as a Physical System	4

Geology

4	Introduction to Oceanography	4
100B	Introduction to Geophysics	4
105	Marine Geology	4
124	Geochemistry	4
136	Geophysics (Seismology and Heat Flow)	4
137	Geophysics (Gravity and Geomagnetism)	4

GRADUATE COURSES

Geology

214	Seminar: Problems in Marine Science	4
235	Plate Tectonics	3
251	Anomaly Interpretation Theory in Gravity and Magnetics	3
252	Geophysical Time Series Analysis	3
255	Advanced Seismology	3

UNDERGRADUATE COURSES

Mechanical Engineering

102	Physical Properties of the Ocean	3
103	Introduction to Marine Technology	3
113	Desalination	3
114	Water Supply and Pollution Control	3
152A	Fluid Mechanics	4
152B	Fluid Mechanics	3

The instructional staff for the courses listed above consists of the following:

BIOLOGICAL SCIENCES

Alldredge, Alice, Ph.D., Assistant Professor of Marine Biology
Case, James F., Ph.D., Professor of Neurobiology
Childress, James J., Ph.D., Associate Professor of Biology
Connell, Joseph H., Ph.D., Professor of Zoology
Davenport, Demorest, Ph.D., Professor of Zoology
Ebeling, Alfred W., Ph.D., Professor or Zoology
Fisher, Steven K., Ph.D., Assistant Professor of Biology
Gibor, Aharom, Ph.D., Professor of Biology
Holmes, Robert W., Ph.D., Professor of Biological Oceanography
Jacobs, Robert S., Ph.D., Associate Professor of Pharmacology
Kuris, Armand M., Ph.D., Assistant Professor of Biology
Melack, John M., Ph.D., Assistant Professor of Biology
Morse, Daniel E., Ph.D., Professor of Genetics and Biochemistry
Murdoch, William W., Ph.D., Professor of Biology
Neushul, Michael, Ph.D., Professor of Marine Botany
Noble, Elmer R., Ph.D., Professor of Zoology Emeritus
Prézelin, Barbara B., Ph.D., Assistant Professor of Biology
Sweeney, Beatrice M., Ph.D., Professor of Biology
Sweet, Samuel S., Ph.D., Assistant Professor of Biology
Trench, Robert K., Ph.D., Associate Professor of Marine Biology
Triplett, Edward L., Ph.D., Associate Professor of Biology
Warner, Robert R., Ph.D., Assistant Professor of Biology
Wenner, Adrian M., Ph.D., Professor of Natural History

ECONOMICS

Deacon, Robert T., Ph.D., Assistant Professor of Economics
Mead, Walter J., Ph.D., Professor of Economics

ENVIRONMENTAL STUDIES PROGRAM

Botkin, Daniel, Ph.D., Professor of Environmental Studies
Schuyler, Arent, Jr., M.A., Lecturer in Environmental Studies
Woodhouse, Charles D., Ph.D., Lecturer in Environmental Studies

GEOGRAPHY

Estes, John E., Ph.D., Associate Professor of Geography
Simonett, David S., Ph.D., Professor of Geography
Smith, Terence R., Ph.D., Professor of Geography
Strahler, Alan H., Ph.D., Assistant Professor of Geography

GEOLOGICAL SCIENCES

Boles, James R., Ph.D., Assistant Professor of Geology
Fuller, Michael D., Ph.D., Professor of Geophysics
Luyendyk, Bruce P., Ph.D., Associate Professor of Marine Geophysics
Norris, Robert M., Ph.D., Professor of Geology
Prothero, William A., Ph.D., Associate Professor of Geology
Sylvester, Arthur G., Ph.D., Associate Professor of Geology
Valentine, James W., Ph.D., Professor of Geology
Wise, William S., Ph.D., Professor of Geology

MECHANICAL ENGINEERING

Bruch, John C., Jr., Ph.D., Associate Professor of Mechanical Engineering
Hickman, Roy S., Ph.D., Professor of Mechanical Engineering
Lick, Wilbert, Ph.D., Professor of Mechanical Engineering
Marschall, Ekkehard P., Dr. Ing., Associate Professor of Mechanical Engineering

To obtain further information, address inquiries to:

Director, Marine Science Institute
University of California, Santa Barbara
Santa Barbara, California 93106
(805) 961-3764

or,

Chairman
Department of Biological Sciences
University of California, Santa Barbara
Santa Barbara, California 93106
(805) 961-2415

UNIVERSITY OF CALIFORNIA, SANTA CRUZ
Santa Cruz, California 95064

The Santa Cruz campus of the University of California is located about 20 miles south of San Francisco on 2,000 acres overlooking Monterey Bay and the Pacific Ocean. The Center for Coastal Marine Studies is the multi-disciplinary unit responsible for coordination of activities concerned with coastal marine problems and for the development of facilities needed to support research and instruction in this marine province.

The main research and tracking facilities of the marine scientists is on the main campus. The research facilities include general-access analytical laboratories for marine biology, chemistry and geology, walk-in algal and invertebrate culture rooms, a histology room, a cruise-staging area and storage rooms. Phase 1 construction at the newly dedicated Joseph M. Long Marine Laboratory, an on-shore marine station within a ten minute drive from campus, has been completed. Two research buildings and outdoor tanks for small marine mammal research are available. A small public aquarium and office are under construction and a major building to support marine analytical research is in the planning stage. Access to nearshore waters is provided by the R/V Scammon, a 40-foot vessel. Fundraising for a 55-foot replacement, which would be specifically designed for neritic research in central California, is underway. A 16-foot Boston whaler and smaller craft are available. The Center also coordinates research activities at Ano Nuevo Island, a major pinniped rookery and haul-out area about 19 miles north of Santa Cruz.

In addition to general research equipment, specialized equipment includes a visible UV spectrophotometer, atomic absorption spectrophotometer, scintillation counter, sediment analysis gear, induction salinometer, Technician auto-analyzer, elemental (CHN) analyzer, PDP computer terminal, water column sampling gear, plankton nets, trawls, corers and refrigerated certrifuge. Collections include a research reference collection of invertebrates and algae of the central California coast.

No undergraduate or graduate degree in the marine sciences is offered. Instead, undergraduate students major in biology, chemistry, earth sciences or physics and concentrate electives in the marine area. Doctorate and Masters degrees are offered in the relevant science disciplines and students meet requirements of the department and undertake a marine-related research problem. Approximately 28 graduate students work on coastal and marine research topics.

The following courses are offered in support of coastal and marine education:

UNDERGRADUATE COURSES

Bio 101	Algae, Fungi and Lichens	5
Bio 121	Invertebrate Zoology	5
Bio 129A-B-C	Problems in Marine Biology	15
Bio 135	Biology of Marine Mammals	5
Bio 140	Principles of Ecology	5
Bio 148	Intertidal Organisms	5
Bio 156	Marine Plankton	5
Bio 157	Biological Oceanography	5
Chem 120	Chemical Oceanography	5
Chem 123	Marine Organic Chemistry	5
Earth Sci 103	Applied Geophysics	5
Earth Sci 110	Global Tectonics	5
Earth Sci 119	The Fossil Record	5
Earth Sci 120	Paleoecology	5
Earth Sci 140	Environmental Geology	5
Earth Sci 145	Hydrology	5
Earth Sci 148	Coastal Geology	5
Earth Sci 160	Stratigraphy-Sedimentation	5
Mar. Sci. 5	Scuba Certification	0
Mar. Sci 17	Oceanography	5
Physics 106	Fluid Dynamics	5
Physics 166	Introduction to Physical Oceanography	5

Summer Session

Introduction to Marine Biology	5
Biology of Marine Vertebrates	5
Kelp Forest Ecology	10
UC Research Diving Certification	0
Problems in Marine Biology	5
Introduction to Aquaculture	5
Natural History of Elkhorn Slough	5

GRADUATE COURSES

Bio 204	Topics in Cryptogam Biology	5
Bio 205	Experimental Phycology	5
Bio 223	Topics in Invertebrate Zoology	5
Bio 226	Topics in Sociobiology	5
Bio 229	Topics in Marine Invertebrate Zoology	5
Bio 244	Topics in Population Biology	5
Bio 245	Topics in Community Ecology	5
Bio 255	Topics in Marine Sciences	5
Bio 256	Marine Plankton	5
Earth Sci 265	Sedimentary Basin Analysis	5
Earth Sci 268	Sedimentary Petrology	5
Earth Sci 280	Advanced Paleontology	5
Earth Sci 290A	Geological Evolution of Crustal Plate Boundaries	5
Earth Sci 290B	Tectonophysics of the Plant Margins	5
Earth Sci 290D	Petrology and Plate Tectonics	5
Earth Sci 290E	Topics in Marine Low Temperature Geochemistry	5
Earth Sci 290G	Topics in Global Tectonics	5
Earth Sci 290H	Structural Geology and Plate Tectonics	5

The faculty which support marine research and instruction consists of the following:

BIOLOGY

Cota-Robles, Eugene, Ph.D., Professor
Doyle, William, Ph.D., Professor
Goff, Lynda, Ph.D., Assistant Professor
Le Boeuf, Burney, Ph.D., Professor
Newberry, A. Todd, Ph.D., Professor
Norris, Kenneth, Ph.D., Professor
Ortiz, Charles, Ph.D., Assistant Professor
Pearse, John, Ph.D., Professor
Potts, Donald, Ph.D., Assistant Professor
Silver, Mary, Ph.D., Assistant Professor

CHEMISTRY

Bruland, Kenneth, Ph.D., Assistant Professor
Crews, Phillip, Ph.D., Associate Professor

EARTH SCIENCES

Gill, James, Ph.D., Associate Professor
Griggs, Gary, Ph.D., Associate Professor
Moore, Casey, Ph.D., Associate Professor
Silver, Eli, Ph.D., Professor

PHYSICS

Flatte, Stanley, Ph.D., Professor
Foster, Theodore, Ph.D., Professor

To obtain further information, address inquiries to:

Dr. William Doyle, Director
Center for Coastal Marine Studies
University of California, Santa Cruz
Santa Cruz, California 95064

UNIVERSITY OF CALIFORNIA, SAN DIEGO
SCRIPPS INSTITUTION OF OCEANOGRAPHY
La Jolla, California 92037

The Scripps Institution of Oceanography has been a unit of the University of California since 1912. It is now part of the University of California San Diego campus, with 11 major buildings clustered on the ocean shore north of the center of La Jolla. The SIO Library holds more than 120,969 bound volumes; 31,854 maps and charts; 20,611 reprints; 30,283 documents, reports, and translations; and 5,782 pieces of microcopy.

Special facilities include: Radio station WWD, operated by the U.S. National Marine Fisheries Service; the Scripps pier, 1,000 feet long, housing apparatus for a number of serial oceanographic observations and used as a landing place for skiffs; the salt water system providing clean seawater to the aquarium and biological laboratories; an underwater area for research and collecting offshore from the institution; deep-sea sediment cores from several thousand widely scattered localities and original echograms and underway geophysical data along several hundred thousand miles of ships' tracks in the oceans of the world; an oceanographic data archive of some half a million bathythermograph observations; electron microprobe laboratories, nine mass spectrometers; several thousand samples of sea water from the world oceans; an electron microscope laboratory; the Scripps fish collection of more than 2,000,000 specimens of some 3,100 species of marine fish, and oceanic samples of plankton. Scripps scientists have access to the university's computer center and have a shipboard computer group with computers on several of the larger ships in the fleet as well as another on the SIO campus.

The Institution operates five ships specially fitted for oceanographic research: Alpha Helix, E.B. Scripps, New Horizon, Thomas Washington, and Melville, and two research platforms: Flip (Floating Instrument Platform) and ORB (Oceanographic Research Buoy).

The Graduate Department of the Institution offers graduate instruction leading to M.S. and Ph.D. degrees in oceanography, marine biology and earth sciences. Emphasis is on the Ph.D. program although the M.S. is awarded if circumstances warrant, either on a comprehensive examination plan or on a thesis plan. No undergraduate major is offered in the department, although most courses are open to enrollment for qualified undergraduate students, with consent of the instructor. Graduate students normally concentrate on one of several curricular programs within the department, including: biological oceanography, marine biology, marine chemistry, geological sciences, geophysics, physical oceanography, and applied ocean sciences. The last is carried out as a joint program with the Department of Applied Mechanics and Engineering Sciences and the Department of Applied Physics and Information Science. The interdisciplinary nature of research in marine sciences is emphasized, and students are encouraged to take courses in several programs and departments and to select research problems of an interdisciplinary nature. The department has no formal language requirements, although some curricular groups require one or two languages or demonstration of ability to use certain foreign languages pertinent to a student's research.

Candidates for admission should have a bachelor's or master's degree in one of the physical, biological or earth sciences; in some cases, a degree in mathematics or engineering science is accepted. The student's preparation should include a solid background in mathematics, physics, chemistry, biology, geology and prior study of at least one foreign language. All students are normally required to take a departmental examination, and the student is expected to demonstrate a comprehension of required subject materials and of the pertinent interactions of physical, chemical, biological or geological factors. After the student has passed the departmental examination and has completed an appropriate period of additional study, the department recommends the appointment of a Doctoral Committee. This committee determines the student's qualification for independent research by means of a qualifying examination and supervises the student's performance and reporting of research. A requirement for the Ph.D. degree is the submission of a dissertation and a final examination at which time the thesis is publicly defended.

The following courses are offered in conjunction with the above programs:

GRADUATE COURSES

207A-B-C	Digital Processing	3, 3, 3
208	Seminar in Applied Ocean Sciences	1
209	Special Topics	1-4
210A	Physical Oceanography	3
210B	Physical Oceanography	3
211A-B	Ocean Waves	3, 3
212A-B	Dynamical Oceanography	3, 3
214	Introduction to Fluid Mechanics	3

215A-B	Experimental Ocean Physics	4, 4
216A	Physics of Sediment Transport	3
216B	Nearshore Processes	3
219	Special Topics in Physical Oceanography	1-4
220	Topics in Geophysical Continuum Mechanics	3
221	Topics in Geophysical Fluid Dynamics	3
222A	Mathematical Tools in Elementary Geomagnetism and Gravity	3
222B	Tensors and Continuum Mechanics	3
223	Geophysical Measurements	3
224	Internal Constitution of the Earth	3
226A-B	Introduction to Marine Geophysics	3, 3
227A-B-C	Seismology	3, 3, 3
228	Structure of Science and Scientific Revolutions	3
229	Geomagnetism	3
230	Introduction to Inverse Theory	3
231A-B	Seismological Methods	3, 3
232	Interpretation of Seismograms	3
233	Seminar on Seismology	3
234	Seminar on Essentials of Geophysics	3
239	Special Topics in Geophysics	1-4
240	Marine Geology	3
241A-B	Continental Margin Sediments	3, 3
243A	Marine Stratigraphy	2
243B	Laboratory in Marine Stratigraphy	2
244	Seminar in Sedimentary Petrology	3
245A	Sedimentary Petrology	3
245B	Sedimentary Geochemistry and Mineralogy	3
246	Oceanic Micropaleontology	3
248A-B-C	Seminar in Marine Geology	3, 3, 3
249	Special Topics in Marine Geology	1-4
250	Coastal Marine Geochemistry	3
251	Thermodynamics of Natural Processes	3
252A	Nuclear Geochemistry	3
252B	Nuclear Geophysics	3
252C	Nuclear Geology	3
253	Igneous and Matamorphic Petrology	3
254	Advanced Igneous Petrology	3
255	Crustal Evolution	3
256A	Field Geology	4
256B	Earth Sciences Spring Field Trip	1
257	Seminar in Petrology	3
258	Seminar in Geology	3
259	Seminar in Geochemistry	2
260	Marine Chemistry	3
261	Physical Chemistry of Seawater	3
263	Major Chemical Cycles in the Sea	3
264	Solids in Nature	3
265	Marine Natural Products Chemistry	3
266	Geochemistry of Organic Compounds	3
267	Management of the Marine Environment	3
268	Seminar in Marine Chemistry	1
269	Special Topics in Marine Chemistry	1-4
270	Pelagic Ecology	3
271	Biological Oceanographic Techniques	4
273	The Evolution of Invertebrates	2
274	Marine Arthropods	4
275A-B	Population and Community Models	3, 3
275C	Topics in Community Ecology	3
275D	Natural History of Coastal Habitats	4
276A-B	Applied Statistics	3, 3
276C-D	Mathematics in Biology	3, 3
277	Deep-Sea Biology	2
278	Problems in Biological Oceanography	2
279	Special Topics in Biological Oceanography	1-4
280	Marine Communities and Environments	3
280L	Laboratory in Marine Organisms	2
281	Environmental Physiology and Biochemistry of Marine Organisms	3
282	Physiology of Marine Vertebrates	3
283	Isotope Tracer Techniques and Related Topics in Physiology	3
284	Cell Physiology of Marine Organisms	4
285	Marine and Comparative Biochemistry	3
285L	Methods in the Comparative Biochemistry of Marine Organisms	4
286	Cellular Structure and Biochemical Function	3
287A	Microbial Ecology	3
287B	Experimental Microbiology	4
287C	Microbial Metabolism	4
287D	Microbial Biosynthesis	3
288	Deuterostome Biology	4
289	Marine Plants	4
291	Physiology of Marine Algae	3
293A-B	Animal Behavior	3, 3
293L	Experimental Laboratory in Animal Behavior	2
294A	Biology of Fishes	4
294B	Seminar in Advanced Ichthyology	2
296	Special Topics in Marine Biology	1-4
297	Marine Biology Seminar	1
298	Special Studies in Marine Sciences	1-2
299	Research	1-12

The instructional staff for the courses listed above consists of the following:

Ahlstrom, E.H., Ph.D., Adjunct Professor of Oceanography
Anderson, V.C., Ph.D., Professor of Applied Physics
Arrhenius, G., Ph.D., Professor of Oceanography
Azam, F., Ph.D., Lecturer in Biology
Backus, G.E., Ph.D., Professor of Geophysics
Bada, J.L., Ph.D., Associate Professor of Oceanography
Bascom, W.N., Adjunct Professor of Applied Ocean Sciences
Benson, A.A., Ph.D., Professor of Biology
Berger, J., Ph.D., Lecturer in Geophysics
Berger, W.H., Ph.D., Associate Professor of Oceanography
Bradner, H., Ph.D., Professor of Engineering Physics
Brune, J.N., Ph.D., Professor of Geophysics
Bullock, T.H., Ph.D., Professor of Neurophysiology
Carlucci, A.F., Ph.D., Lecturer in Marine Biology
Cox, C.S., Ph.D., Professor of Oceanography
Craig, H., Ph.D., Professor of Geochemistry and Oceanography
Curray, J.R., Ph.D., Professor of Marine Geology
Davis, R.E., Ph.D., Professor of Oceanography
Dayton, P.K., Ph.D., Associate Professor of Oceanography
Dorman, L.M., Ph.D., Associate Professor of Geophysics
Engel, A.E.J., Ph.D., Professor of Geology
Enns, T., Ph.D., Lecturer in Marine Biology
Enright, J.T., Ph.D., Professor of Oceanography
Eppley, Richard W., Ph.D., Lecturer in Oceanography
Evans, W.E., Ph.D., Lecturer in Marine Biology
Faulkner, D.J., Ph.D., Associate Professor of Oceanography
Fenical, W.H., Ph.D., Lecturer in Marine Chemistry
Fisher, F.H., Ph.D., Lecturer in Oceanography
Fleminger, A., Ph.D., Lecturer in Marine Biology
Gibson, C.H., Ph.D., Associate Professor of Engineering Physics
Gieskes, J.M., Ph.D., Associate Professor of Oceanography
Gilbert, J.F., Ph.D., Professor of Geophysics
Goldberg, E.D., Ph.D., Professor of Chemistry

Goodman, D., Ph.D., Assistant Professor of Theoretical Ecology
Guza, R.T., Ph.D., Assistant Professor of Oceanography
Hamilton, E.L., Ph.D., Adjunct Professor of Oceanography
Hammel, H.T., Ph.D., Professor of Physiology
Haubrich, R.A., Ph.D., Professor of Geophysics
Hawkins, J.W., Ph.D., Professor of Geology
Haxo, F.T., Ph.D., Professor of Biology
Heiligenberg, W.F., Ph.D., Professor of Behavioral Physiology
Hemmingsen, E.A., Ph.D., Lecturer in Physiology
Hendershott, M.C., Ph.D., Professor of Oceanography
Hessler, R.R., Ph.D., Professor of Oceanography
Hodkiss, W.S., Ph.D., Assistant Professor of Electrical Engineering
Holland, N.D., Ph.D., Professor of Marine Biology
Holm-Hansen, O., Ph.D., Lecturer in Marine Biology
Hunter, J.R., Ph.D., Associate Adjunct Professor of Oceanography
Inman, D.L., Ph.D., Professor of Oceanography
Isaacs, J.D., B.S., Professor of Oceanography
Jordan, T.H., Ph.D., Associate Professor of Geophysics
Kastner, M., Ph.D., Associate Professor of Geology
Keeling, C.D., Ph.D., Professor of Oceanography
Knox, R.A., Ph.D., Lecturer in Physical Oceanography
Lal, D., Ph.D., Professor of Nuclear Geophysics
Lange, G.D., Ph.D., Associate Professor of Neurosciences
Lasker, R., Ph.D., Adjunct Professor of Marine Biology
Lewin, R.A., Ph.D., Professor of Biology
Lonsdale, P.F., Ph.D., Lecturer in Geology
Macdonald, K.C., Ph.D., Lecturer in Geophysics
Macdougall, J.D., Ph.D., Assistant Professor of Earth Sciences
McGowan, J.A., Ph.D., Professor of Oceanography
Menard, H.W., Ph.D., Professor of Geology (on leave of absence)
Mudie, J.D., Ph.D., Associate Professor of Geophysics
Mullin, M.M., Ph.D., Chairman and Professor of Oceanography
Munk, W.H., Ph.D., Professor of Geophysics
Nealson, K.H., Ph.D., Associate Professor of Marine Biology
Newman, W.A., Ph.D., Professor of Oceanography
Nierenberg, W.A., Ph.D., Professor of Physics, Dean and Director, Scripps Institution of Oceanography, and Vice Chancellor-Marine Sciences, University of California, San Diego
Orcutt, J.A., Ph.D., Lecturer in Geophysics
Parker, R.L., Ph.D., Professor of Geophysics
Peterson, M.N.A., Ph.D., Associate Professor of Oceanography
Pinkel, R., Ph.D., Lecturer in Oceanography
Reid, J.L., M.S., Professor of Oceanography
Riedel, W.R., Ph.D., Senior Lecturer in Oceanography
Rosenblatt, R.H., Ph.D., Professor of Marine Biology
Salmon, R.L., Ph.D., Assistant Professor of Oceanography
Shor, G.G., Ph.D., Professor of Marine Geophysics
Somero, G.N., Ph.D., Associate Professor of Biology
Spiess, F.N., Ph.D., Professor of Oceanography
Stewart, R.M., Ph.D., Lecturer in Oceanography
Thierstein, H.R., Ph.D., Assistant Professor of Geology
Vacquier, V.D., Ph.D., Associate Professor of Marine Biology
Van Atta, C.W., Ph.D., Professor of Engineering Physics and Oceanography
Venrick, E.L., Ph.D., Lecturer in Oceanography
Volcani, B.E., Ph.D., Professor of Microbiology
Weiss, R.F., Ph.D., Lecturer in Geochemistry
White, F.N., Ph.D., Professor of Physiology
Winant, C.D., Ph.D., Associate Professor of Oceanography
Winterer, E.L., Ph.D., Professor of Geology

To obtain further information, address inquiries to:

Dr. Michael M. Mullin, Chairman
Graduate Department A-008
Scripps Institution of Oceanography
La Jolla, California 92093

THE UNIVERSITY OF CONNECTICUT
MARINE SCIENCES INSTITUTE
Avery Point, Groton, Connecticut 06340

The Marine Sciences Institute of the University of Connecticut is located at Avery Point in Groton, on the campus of the Southeastern Branch of the University, opposite New London, where the Thames River meets Long Island Sound. Here the Institute occupies two buildings, with a total of more than 50,000 square feet of space, housing laboratories including a Class 100 Ultra Clean Laboratory for trace metal analysis, offices, shops, and classrooms. The Avery Point facilities are used for research and teaching in chemical and physical oceanography, marine geology, geophysics and marine ecology.

A second facility is located in Noank at the mouth of the Mystic River; it includes a 7,000 square foot building, housing laboratories, offices, a shop, and a marine biology library. The building is used exclusively for biological studies; it contains a continuous salt-water system, a 1,500 gallon aquarium and conventional laboratory equipment to conduct fisheries and biological research.

The Institute has a fleet of small boats docked along a 125-foot long pier at the Noank facility. The fleet consists of a 65-foot T-boat, the steel-hulled R/V Uconn, a 34-foot lobster boat, the Libinia; a 24-foot Sea Ray, the Husky; a whaleboat, several Boston Whalers, and smaller skiffs. Personnel to man these boats are located at Noank.

The Institute's marine library was started in 1969 and has continued to grow; it now includes more than 5,000 publications. An IBM 3774 reader/printer remote computer terminal provides access to the University IBM 370/155/168 computer over leased telephone lines. The Institute has basic research equipment used for conducting investigations in oceanography and related fields. Laboratory instruments include an x-ray diffraction unit; a gas chromatograph, infra-red and UV-visible spectrophotometers, atomic absorption spectrophotomers, anodic stripping equipment, and conventional equipment used in marine geological laboratories. Seagoing instruments include corers, dredges, underwater cameras, plankton nets, current meters, a towed magnetometer, a seismic air gun and sparkers, and sonobuoy.

Also on hand are: magnetometers, an anemometer and wind vane (to record windspeed and direction), a standard air temperature thermograph, a barograph and a tide gage. These data are available for research purposes. At Noank, a tide gage and older meteorological instruments have been making continuous recordings since 1958.

The following degrees are offered:

1. Master of Science in Marine Biology and Oceanography - 15 credits of advanced coursework and a thesis.

2. Doctor of Philosophy in Oceanography - completion of 24 credits of advanced coursework, a reading knowledge of French, German or Russian, and a dissertation.

The following courses are offered:

UNDERGRADUATE COURSES (offered in the Biological Sciences Group and Department of Geology and Geophysics)

Biology

236	Marine Microbiology	3
244	General Ecology	3
275	Invertebrate Zoology	4
290	Introductory Phycology	4
292	Principles of Ecology	4
294	Marine Biology	3
295	Methods in Underwater Research	3

Geology and Geophysics

219	Invertebrate Paleontology	4
245	Introduction to Geochemistry	3
170	Introduction to Oceanography	3
270	Descriptive Physical Oceanography	3
275	Geological Oceanography	3

GRADUATE COURSES (offered in the Biological Sciences Group and Department of Geology and Geophysics)

Biology

395	Independent Study	Variable
396	Investigations of Special Topics	Variable
443	Marine Ecology	4
444	Marine Ichthyology	3
445	Advanced Invertebrate Zoology	4
447	Mathematical Ecology	3
450	Population Ecology	3
460	Advanced Phycology	3
461	Pathobiology of Invertebrates	3
469	Seminar	Variable

Geology and Geophysics

314-15	Micropaleontology I and II	8
318	Special Topics in Sedimentation and Diagenesis	3
368	Marine Geology	3
351	Aqueous Geochemistry	3
370	Dynamical Physical Oceanography	3
371	Chemical Oceanography	3
372	Sediment Transport	3
376	Estuarine Circulation	3
377	Ocean Waves	3
378	Advanced Dynamical Oceanography	3
379	Seminar in Chemical Oceanography	3
410	Special Topics in Oceanography	Variable

The instructional staff for the courses listed above consists of the following:

Bohlen, W.F., Ph.D., Assistant Professor of Physical Oceanography
Buck, J.D., Ph.D., Associate Professor of Microbiology
Dehlinger, P., Ph.D., Professor of Geophysics
Dowling, J.J., Ph.D., Associate Professor of Geophysics
Feng, S.Y., Ph.D., Professor of Biology and Director of the Marine Sciences Institute
Fitzgerald, W.F., Ph.D., Associate Professor of Chemical Oceanography
Frankel, L., Ph.D., Professor of Geology
Tolmazin, D., Candidate, Associate Professor of Physical Oceanography
Waslenchuk, D.G., Ph.D., Assistant Professor of Geological Oceanography
Welsh, B.L., Ph.D., Assistant Professor of Biology
Whitlatch, R.B., Ph.D., Assistant Professor of Biology

To obtain further information, address inquiries to:

The Director
Marine Sciences Institute
The University of Connecticut
Avery Point, Groton, Connecticut 06340

UNIVERSITY OF CHICAGO
Chicago, Illinois 60637

The marine sciences program at the University of Chicago is within the Department of the Geophysical Sciences, located in the Henry Hinds Laboratory for the Geophysical Sciences. The central core of the building consists almost entirely of research laboratories and associated shop facilities. Among these are several wave tank laboratories which include wave tanks up to 80 feet long used for impulse wave and ocean wave studies, random wave and interaction studies, and internal wave investigations. Other facilities include a flume, wind tunnel, paleoecology laboratory, sedimentology laboratory, hydrodynamics laboratory, geochemistry laboratories, an electron microprobe, and x-ray diffraction equipment. The university computing center is nearby. Field facilities are available through cooperation with the Woods Hole Oceanographic Institution.

Degrees are not offered specifically in the marine sciences or oceanography. The M.S. and Ph.D. degrees in the Geophysical Sciences are offered with specialization in the areas included within the marine sciences.

Master of Science (Geophysical Sciences). The requirements for this degree are: a program of study approved by the departmental counselor, normally consisting of nine graduate courses (at least three basic science courses and at least three geophysical science courses and at least one research course); courses in basic science may be taken in or outside the department, and an average grade of not lower than B and no grade lower than C in the courses offered for the degree.

Doctor of Philosophy (Geophysical Sciences). The requirements are: a program of study approved by the student's advisory committee; pass a reading comprehension examination in a foreign language, a preliminary examination consisting of a written part covering fields that the student has selected for his program of study, followed by an oral part based on the student's proposal for a dissertation topic that he has submitted as a research prospectus, and a dissertation by the candidate on the results of independent research in the geophysical sciences, followed by an oral final examination on the dissertation and the field of specialization.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

132	Evolution and Earth History	3
133	The Atmosphere and Oceans	3
222	Paleoceanography	3
232, 233	Dynamics and Phenomenology of the Atmosphere and Oceans	3
269	Geophysical Fluid Dynamics Laboratory	3

GRADUATE COURSES

302	Hydrodynamic Stability	3
303	Turbulence	3
318	Paleoecology	3
320	Early Diagenesis of Sediments	3
343	Ocean Wave Theory	3
348	Shallow-water Oceanography	3
351	Geophysical Fluid Dynamics I: Fundamentals	3
352	Geophysical Fluid Dynamics II: Viscous Flows	3
353	Geophysical Fluid Dynamics III: Waves	3
354	Geophysical Fluid Dynamics IV: Large-scale Atmospheric Motions	3
355	Geophysical Fluid Dynamics V: Large-scale Oceanic Motions	3
356	Geophysical Fluid Dynamics VI: Laboratory Models	3
361	Atmospheric Convection	3
362	Numerical Weather Prediction	3
381	Tides of the Geosphere	3

RESEARCH COURSES

441	Research in Dynamical Oceanography	3
460	Research in Geophysical Fluid Dynamics	3
461	Research in Dynamical Prediction	3
462	Research in Hydrodynamical Models	3
463	Research in Experimental Hydrodynamic Stability	3
464	Research in Convection	3
466	Research in Theoretical Fluid Mechanics	3
481	Research in Marine Geophysics	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF GEOPHYSICAL SCIENCES

Aller, Robert C., Ph.D., Assistant Professor of Marine Geochemistry
Fultz, Dave, Ph.D., Professor of Meteorology
Kuo, Hsiao-Lan, Ph.D., Professor of Meteorology
McGoldrick, Lawrence F., Ph.D., Associate Professor of Fluid Mechanics
Platzman, George W., Ph.D., Professor of Meteorology
Schopf, Thomas J.M., Ph.D., Associate Professor of Paleobiology
Sepkoski, J. John, Ph.D., Assistant Professor of Paleobiology
Srivastava, Ramesh C., Ph.D., Associate Professor of Meteorology

To obtain further information, address inquiries to:

Kay Taylor
Department of Geophysical Sciences
The University of Chicago
5734 South Ellis Avenue
Chicago, Illinois 60637

UNIVERSITY OF DELAWARE
Newark (19711) and Lewes (19958), Delaware

Marine studies are conducted through a graduate program in the College of Marine Studies; various other departments offer undergraduate and graduate degrees with marine specialties (School of Life and Health Sciences, Departments of Economics, Geology, Geography, Civil Engineering and Political Science).

Marine studies are conducted on the main campus in Newark and at the Marine Studies Complex in Lewes. Equipment and facilities available at both sites support a broad spectrum of research, including controlled environment mariculture; salt marsh ecology; physiological ecology of marine organisms; salt-tolerant food plants; coastal vegetation; coastal sedimentary processes; remote sensing of marine resources; trace metals in salt marshes; and coastal zone management, among others.

Created in 1970 to focus the University's marine programs, the College of Marine Studies is a multidisciplinary, graduate-level institution that provides opportunities for study and research in marine biology, marine geology, ocean engineering, physical oceanography, chemical oceanography and marine affairs. At the main campus in Newark are some physical and chemical oceanogrphy and marine biology laboratories. The Newark campus also includes research facilities of allied departments, such as biological sciences, chemistry, geology, geography, civil engineering, and mechanical and aerospace engineering, as well as the main library and the computing center.

Facilities at Lewes include the 38,000 square foot Cannon Marine Studies Laboratory, a classroom/laboratory/administration building with a circulating seawater system, library, and data processing center. An 8,000 square foot marine operations building with facilities for ship operations and communications, net repair, equipment storage, and scientific assembly, is located alongside a four and one-half-acre harbor. The harbor is home to the 120-foot R/V Cape Henlopen, an all-aluminum vessel designed specifically for coastal zone and continental shelf work, and two smaller (42 and 47 foot) research vessels. Smaller boats are also available. Portable laboratory vans may be outfitted for specialized research and mated directly to the Cape Henlopen or to a laboratory or assembly area in either the Cannon Laboratory or the marine operations building.

Other facilities in Lewes include a 24,000 square foot mariculture laboratory, due to be completed in late 1979, a residential/seminar facility, to be completed during summer 1980, and a wind-wave-current facility for research on air-sea interaction, just dedicated in summer, 1979. Laboratories for pollution ecology, biology, chemistry and marine sediments are located at four other sites in Lewes.

The following degrees and their related courses are offered:

SCHOOL OF LIFE AND HEALTH SCIENCES

1. Bachelor of Arts with option in marine biology.
2. Master of Science (with specialization in marine biology).
3. Ph.D. Degree (with specialization in marine biology).

BIOLOGICAL SCIENCES

B 623	Parasitology	4
B 630	Ichthyology	4
B 634	Advanced Invertebrate Zoology	4
B 636	Protozoology	3
B 637	Population Ecology	3
B 638	Communities and Ecosystems	3
B 641	Microbial Ecology	4
B 651	Comparative Animal Physiology	3
B 666	Special Problem	1-6
B 671	Immunobiology	3
B 674	Limnology	3
B 868	Research	1-9
B 869	Master's Thesis	1-6
B 969	Ph.D. Dissertation	1-12

FACULTY

Eisenberg, Robert M., Ph.D., Associate Professor
Francis, David W., Ph.D., Professor
Hurd, Lawrence E., Ph.D., Assistant Professor
Smith, David W., Ph.D., Assistant Professor
Tripp, Marenes R., Ph.D., Professor

DEPARTMENT OF GEOGRAPHY

1. Bachelor of Arts
2. Master of Arts or Master of Science

GEOGRAPHY

G 220	Meteorology	3
G 320	Water Resources	3
G 620	Advanced Meteorology	3
G 651	Microclimatology	3
G 652	Seminar in Climatology	3
G 672	Remote Sensing of Earth Resources	3
G 855	Climatological Research	3

FACULTY

Bunkse, Edmunds V., Ph.D., Assistant Professor
Field, Richard T., M.S., Lecturer
Kalkstein, Laurence S., Ph.D., Assistant Professor
Klemas, Vytautas, Ph.D., Professor
Mather, John R., Ph.D., Professor and Chairman
Meierding, Thomas C., Ph.D., Assistant Professor
Rees, Peter W., Ph.D., Associate Professor
Ulrich, Roger S., Ph.D., Assistant Professor
Willmott, Cort J., Ph.D., Assistant Professor

DEPARTMENT OF GEOLOGY

1. Bachelor of Science
2. Master of Science in Geology
3. Ph.D. in Geology

GEOLOGY

GEO 331	Geology of the World's Oceans	3
GEO 609	Dynamic Processes in Sedimentation	3
GEO 611	Quantitative Geomorphology	3
GEO 631	Marine Geology	3
GEO 632	Geology of Recent Sedimentary Environments	3
GEO 634	The Geology of Coasts	3
GEO 653	Elementary Geophysics I	3
GEO 666	Special Problem	1-6
GEO 806	Micropaleontology	3
GEO 830	Geological Oceanography	3
GEO 853	Applied Seismology	3
GEO 866	Special Problem	1-6

FACULTY

Biggs, Robert B., Ph.D., Associate Professor
Glass, Billy P., Ph.D., Associate Professor
Jordan, Robert R., Ph.D., Associate Professor
Kraft, John C., Ph.D., Professor and Chairman
Sheridan, Robert E., Ph.D., Associate Professor
Swain, Frederick M., Ph.D., Professor
Thompson, Allan M., Ph.D., Associate Professor
Wehmiller, John F., Ph.D., Assistant Professor

COLLEGE OF MARINE STUDIES

1. Master of Arts or Master of Science in Marine Studies.

The College distinguishes between the M.A. and M.S. degrees by the specialization selected by the student.

2. Master of Marine Policy.

3. Ph.D. in Marine Studies.

Each Ph.D. applicant must fulfill the university residence requirement of one continuous academic year.

The following courses are offered by the College. These courses may be supplemented by marine-related offerings in other departments.

MARINE STUDIES

CMS 200	Introduction to Oceanography	3
CMS 600*	Concepts in Physical Oceanography	3
CMS 602	Oceanic and Atmospheric Dynamics	3
CMS 603	Fluid Dynamics of Estuaries	3
CMS 604	Air-Sea Interactions I	3
CMS 605	Air-Sea Interactions II	3
CMS 606	Geophysical Fluid Dynamics I	3
CMS 607	Geophysical Fluid Dynamics II	3
CMS 608	Coastal/Ocean Fluid Dynamics	3
CMS 609	Oceanic and Atmospheric Circulation	3
CMS 615*	Concepts in Biological Oceanography	3
CMS 616	Malacology: Biology of the Mollusca	3
CMS 617	Tide Marsh Ecology	3
CMS 618	Zooplankton Biology	3
CMS 619	Introductory Marine Biology	4
CMS 620	Principles of Toxicology	3
CMS 622	Marine Food Technology	
CMS 627	Marine Botany	3
CMS 628	Introductino to Estuarine and Coastal Ecology	4
CMS 629	Topics in Marine Biology	3
CMS 630*	Concepts in Marine Geology	3
CMS 631	Marine Geology	3
CMS 645	Concepts in Chemical Oceanography	1
CMS 646	Chemical Oceanography	3
CMS 647	Physical Chemistry of Seawater	3
CMS 648	Marine Geochemistry	3
CMS 649	Organic Chemical Oceanography	3
CMS 650	Clay Mineralogy	3
CMS 652	Marine Algal Biochemistry/Physiology	3
CMS 670*	Concepts in Marine Affairs	3
CMS 671-72	Maritime History	3, 3
CMS 673	International Law	3
CMS 674	Legal Aspects of the Coastal Zone	3
CMS 675	Economics of Natural Resources	3
CMS 676	Maritime Law	3
CMS 677	Benefit/Cost Analysis	3
CMS 678	Environmental Law	3
CMS 680*	Concepts in Applied Ocean Science	1
CMS 681	Remote Sensing of the Environment	3
CMS 482/682	Remote Sensing in Agriculture	2
CMS 683	Structural Materials in Seawater	3
CMS 817	Biology of Marine Larvae	4
CMS 818	Invertebrate Metabolism	3
CMS 819	Benthic Ecology	3
CMS 827	Current Topics in Marine Biology	2-4
CMS 828	Marine Invertebrates	4
CMS 866	Special Problem	1-6
CMS 868	Research	1-9
CMS 869	Master's Thesis	1-6
CMS 969	Ph.D. Dissertation	1-6

*Concept Courses

FACULTY

Forty-nine faculty members hold appointments in the College of Marine Studies. Many of these hold joint appointments with other departments within the University (noted in parentheses).

Abbott, R. Tucker, Ph.D., Adjunct Professor
Anderson, Lee G., Ph.D., Associate Professor (Economics)
Austin, Paul R., Ph.D., Adjunct Professor
Biggs, Robert B., Ph.D., Associate Professor and Associate Dean (Geology)
Bolton, Ellis, Ph.D., Professor
Carriker, Melbourne R., Ph.D., Professor
Castle, John E., Ph.D., Adjunct Professor
Church, Thomas M., Ph.D., Associate Professor (Chemistry)
Culberson, Charles H., Ph.D., Assistant Professor
Daiber, Franklin C., Ph.D., Professor (Biological Sciences)
Dalrymple, Robert A., Ph.D., Associate Professor (Civil Engineering)
Dean, Robert G., Ph.D., Professor (Civil Engineering)
Dexter, Stephen C., Ph.D., Assistant Professor
Epifanio, Charles E., Ph.D., Associate Professor
Gaither, William S., Ph.D., Professor and Dean of CMS (Civil Engineering)
Garvine, Richard W., Ph.D., Associate Professor
Gibbs, Ronald J., Ph.D., Professor
Gibson, James R., Ph.D., Adjunct Associate Professor
Glass, Billy P., Ph.D., Associate Professor (Geology
Huang, Norden E., Ph.D., Adjunct Professor
Hurd, Lawrence E., Ph.D., Assistant Professor (Biological Sciences)
Jordan, Robert R., Ph.D., Associate Professor (Geology)
Klemas, Vytautas, Ph.D., Professor (Geography)
Kraft, John C., Ph.D., Professor (Chairman of Geology)
Lewis, Thomas B., J.D., Visiting Lecturer
Lotrich, Victor A., Ph.D., Associate Professor (Biological Sciences)
Lozano, Carlos J., Ph.D., Assistant Professor (Mathematics)
Lundin, Leroy R., Ph.D., Assistant Professor (Mathematics)
Mangone, Gerald J., Ph.D., Professor (Political Science)
Maurer, Donald L., Ph.D., Associate Professor (Biological Sciences)
Merrill, James M., Ph.D., Professor (History)
Oliver, James K., Ph.D., Associate Professor (Political Science)
Pleass, C.M., Ph.D., Lecturer
Price, Kent S., Ph.D., Associate Professor and Associate Dean (Biological Sciences)
Pruder, Gary S., Ph.D., Assistant Professor
Sharp, Jonathan H., Ph.D., Assistant Professor
Sheridan, Robert E., Ph.D., Associate Professor (Geology)
Smith, David W., Ph.D., Assistant Professor (Biological Sciences)
Somers, G. Fred, Ph.D., Professor (Biological Sciences)
Swain, Frederick M., Ph.D., Professor (Geology)
Taylor, Malcolm, Ph.D., Assistant Professor (Biological Sciences)
Thoroughgood, Carolyn A., Ph.D., Associate Professor (Human Resources)
Vinson, Jack R., Ph.D., Professor (Chairman of Mechanical and Aerospace Engineering)
Wang, Hsiang, Ph.D., Professor (Civil Engineering)
Warren, Robert, Ph.D., Professor (Urban Affairs)
Wehmiller, John F., Assistant Professor (Geology)
Wood, Robert H., Ph.D., Professor (Chemistry)
Wu, Jin, Ph.D., Professor (Civil Engineering)
Yang, Cheng Y., Ph.D., Professor (Civil Engineering)

To obtain further information, address inquiries to:

Dr. Robert B. Biggs, Associate Dean
College of Marine Studies
University of Delaware
Newark, Delaware 19711

DEPARTMENT OF CIVIL ENGINEERING

Ocean engineering courses are offered both at the main campus in Newark and at the College of Marine Studies complex in Lewes. On-campus laboratory facilities are located primarily within the Departments of Civil Engineering and Mechanical and Aerospace Engineering. The fluid mechanics laboratory contains a combined towing and wave tank with eight-foot by five-feet test section, a 90-foot long wave tank, a free surface hydrodynamic tank with a four-foot by six-foot test section, a rotating flow table and a ripple tank. A number of oceanic research vessels and a 50-foot by 50-foot wave basin are frequently used facilities at Lewes.

The environmental engineering laboratories are equipped for chemical and biological analyses of water. Specialized equipment includes stability indicator, turbidimeter, BOD apparatus, Kjeldahl N viscometer, Warburg respirator, CHN analyzer, and a D.O. probe accurate to one part per billion of dissolved oxygen.

Well-equipped soil mechanics, metallurgical and structural laboratories are also available for marine-oriented research.

The University offers the following degrees:

1. Bachelor of Civil Engineering - with specialization in Ocean Engineering (Department of Civil Engineering).

2. Master of Civil Engineering - with specialization in Ocean Engineering.

3. Ph.D. in Applied Science - with specialization in Ocean Engineering.

The following courses are offered in conjunction with the above programs:

CIVIL ENGINEERING

CE 633	Physical Aspects of Environmental Engineering	3
CE 637	Water Quality and Pollution	3
CE 639	Hydromechanics	3
CE 666	Special Project	1-6
CE 667	Special Problem: Water/Wave Theory	3
CE 671	Ocean Engineering	3
CE 672	Topics in Ocean Engineering	3
CE 673	Marine Soils Engineering	4
CE 674	Coastal and Estuarine Geotechnique	3
CE 675	Engineering in a Coastal Environment	3
CE 683	Probabilistic Engineering Analysis	3
CE 815	Probabilistic Structural Engineering	3
CE 916	Structural Dynamics	3
CE 831	Theory of Water Treatment	3
CE 832	Theory of Waterwater Treatment	3
CE 834	Advanced Water Resources Engineering	3
CE 837	Mechanics of Free Surface Flow	3
CE 839	Applied Hydraulics	3
CE 870	Marine Hydrodynamics	3
CE 871	Marine Structures	3
CE 874	Geophysical Fluid Mechanics	3

GEOGRAPHY

G 220	Meteorology	3

GEOLOGY

GEO 631	Marine Geology	3
GEO 632	Geology of Recent Sedimentary Environments	3

MECHANICAL AND AEROSPACE ENGINEERING

MAE 622	Introduction to Stability and Control	3
MAE 633	Hydromechanics	3
MAE 833	Fluid Mechanic Stability	3
MAE 611	Principles of Continuum Mechanics	3

MATERIALS AND METALLURGY

MET 611	Corrosion and Corrosion Control	3

DEPARTMENT OF CIVIL ENGINEERING

Dalrymple, R.A., Ph.D., Assistant Professor
Dean, R.G., Ph.D., Distinguished Professor
Wang, Hsiang, Ph.D., Professor
Yang, Cheng Y., Ph.D., Professor

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

Greenberg, Michael E., Ph.D., Professor
Vinson, Jack R., Ph.D., Professor

COLLEGE OF MARINE STUDIES

Gaither, William S., Ph.D., Professor and Dean
Klemas, Vytautas, Ph.D., Professor
Wu, Jin, Ph.D., Professor

To obtain further information, address inquiries to:

Ocean Engineering Program
Department of Civil Engineering
University of Delaware
Newark, Delaware 19711

UNIVERSITY OF FLORIDA
Gainesville, Florida 32611

The University is involved in a broad array of marine-related activities beyond formal curricula. The specialized facilities discussed below are directly used in education. For the most part, the

University of Florida's curricula in the marine sciences are formally established at the graduate level, wherein a student conducts research and is permitted broad flexibility in coursework.

Off-campus laboratories provide easy access to both the Gulf and Atlantic coasts. Within an hour's drive the superb variety of marine and estuarine communities of the Gulf of Mexico is available through the facilities of the University of Florida Marine Laboratory on Seahorse Key, which is located three miles offshore, opposite Cedar Key. Living accommodations are provided in a 10-room lighthouse and a 20 by 40-foot laboratory building, complete with running sea water available for research use. The Laboratory maintains a 33-foot research vessel equipped for dredging, trawlings, and scuba work and a number of smaller outboard-powered boats for shallow water and inshore use. A dock and marine railway are situated next to the laboratory. The location at Sea Horse Key provides ease of access to diverse habitats ranging from freshwater rivers, estuaries and salt marshes to the marine water of the Gulf of Mexico. Clark Island and the surrounding waters, amounting to 41 acres, located near Sea Horse Key belong to the University of Florida. This undisturbed area is available for use in intensive studies of estuarine resources and processes. The Florida Institute for Oceanography (FIO) provides deep water oceanographic vessels for University personnel, thus extending the capabilities of the Laboratory. Ship time is obtained upon approval of submitted proposals to FIO.

The C.V. Whitney Marine Research Laboratory at Marineland in Flagler County on the Atlantic coast is only two hours away from Gainesville and offers modern facilities for biochemical, behavioral, biomedical, fish and marine mammal research. The habitats available for study here include those associated with a high-energy coastline as well as the unique coquina rock outcrop. Both laboratories have accommodations for extended stays.

The Marine Biology Program is part of the curriculum of the Department of Zoology. On-campus facilities for a wide range of experimental programs include two large saltwater aquarium rooms, controlled environmental chambers, culture rooms, data-sensing instrumentation, standard analysis laboratories, scanning and transmission electron microscopes, minicomputers, and terminals for access to the University Computer Center. The Florida State Museum, adjacent to the Department's Bartram Hall, maintains significant collections available for research purposes. The program in Marine Biology receives interdisciplinary support from faculty and facilities drawn from other units within the University, including Botany, Geology, Microbiology and Cell Science, Medicine, Pharmacy, Environmental Engineering, Florida State Museum, Biochemistry, Communication Sciences, Coastal and Oceanographic Engineering, Statistics, Computer Science, Food Sciences, Wildlife and Resource Management, Center for Wetlands, Sea Grant and the Marine Advisory Service. Research and class cruises, provided by FIO and the University of Florida Marine Laboratory, give essential training and experience in gear handling, sampling techniques, and analysis of marine community structure. The Department of Zoology offers programs of study leading to the M.S. and Ph.D. degrees with research specializations in most areas of classical and experimental zoology, including a broadly based program in marine biology. Among the areas of current emphasis are basic and applied studies in marine ecology, zoogeography, sensory physiology, ichthyology, systematics, population genetics, and ethology.

The Communication Sciences Laboratory is located in the Department of Speech. Created in 1965, the laboratory has a full-time faculty of 18 and is devoting considerable effort to underwater speech communication. This work is supported by the U.S. Navy and utilizes six Navy laboratories including their research station at Bugg Springs in the central portion of the state.

The Florida State Museum serves as a center for research in anthropology and natural history. Strongly oriented toward basic research, it carries a dual responsibility as both the state and university museum. Of particular interest to the aquatic sciences are the collections of reptiles, amphibians, fishes and molluscs. Completion of a new museum facility on the campus adjacent to the life sciences building complex has afforded a greatly increased opportunity for research, interpretive displays and an even greater level of cooperation with other units of the university. The new facility includes aquarium rooms which will be of value to many areas of the aquatic, estuarine and marine sciences.

The academic and research programs in the Coastal and Oceanographic Engineering Department are oriented toward the physical aspects of coastal and ocean engineering. Both basic and applied laboratory and field studies are conducted in the Coastal Laboratory in Gainesville and at numerous locations on the coast of Florida. The Laboratory facilities include: 1) large, enclosed areas for hydraulic model studies, 2) an air-sea interaction facility with random wave generation capability, 3) two stratified flow-internal wave facilities for studying stratified shear flows, subsurface wave phenomena, flow stability, horizontal dispersion in bays, etc., 4) a wave tank in which the effects of waves on structures, sand motion and other variables can be investigated, 5) a hydraulic tilting flume as well as a rotating ring-channel system for basic studies of the interaction of flows with sediments. A coastal data network consisting of bottom mounted pressure transducers located approximately one kilometer offshore at numerous locations around the state connected to shore and the telephone system by underwater cables allow real time wave and tide measurement from the central computer in the Coastal Laboratory in Gainsville.

Research presently being conducted includes the following general areas: nearshore sediment transport, beach and dune erosion under storm conditions, waves, friction factors associated with arrested salt wedges, tidal inlet hydraulics and stability, marina siltation and water quality problems, nature assisted beach nourishment, prediction of hurricane-associated sea severity, and criterion for the establishment of a coastal construction setback line.

The Florida State Grant College is administered at the University of Florida on behalf of the State University System of Florida and affiliated private institutions. Faculty and their students in many departments, including food science, veterinary medicine, nursing, architecture, forestry, and others not offering many marine-oriented courses, have received Sea Grant support.

The following graduate degrees are offered (and the number of degrees awarded last year in parenthesis):

1. Master of Science (4) and Ph.D. (5) in Botany. Requirements include core undergraduate courses and recommendations of the supervisory committee.

2. Master of Science (5), Master of Engineering (1), Engineer (0) in Coastal and Oceanographic Engineering. (The Ph.D. degree is offered through one of the other departments in the College of Engineering.) A Bachelor's degree in engineering or physical sciences or articulation work is necessary for acceptance to the program.

3. Master of Science in Geology (12). Required are the core undergraduate courses and a recommended summer field course.

4. Master of Science (8) and Ph.D. (1) in Zoology. Requirements are the core curriculum and recommendations of the supervisory committee based on written examinations.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

BOT 3043	Introduction to Ecology	5
BOT 3153	Local Flora	3
BOT 3173	Weed Identification	2
PCB 5046	Advanced Ecology	4
BOT 5405	Phycology	5
BOT 5435	Introductory Mycology	5
BOT 5485	Mosses and Liverworts	5
BOT 5695	Ecosystems of Florida	5
BSC 2010	Organismic Biology	4
BSC 2011	Molecules and Cells	4
BSC 2012	Populations and Communities	4
PCB 3063	Genetics	5
GLY 4700	Geomorphology	4
GLY 5241	Geochemistry	4
GLY 5555	Sedimentology	4
GLY 5734	Marine Geology	4
OCE 4005	Introductory Oceanography	4
OCE 4016	Introduction to the Coastal and Oceanographic Environment	4
OCP 4290	Coastal Hydraulics	3
EOC 5052	Ocean Engineering	4
EOC 5310	Acoustics in Fluids	4
EOC 5318	Introduction to Ocean Chemistry for Engineers	4
EOC 5860	Harbor Engineering	4
ZOO 3203	Invertebrate Zoology	5
ZOO 3303	Vertebrate Zoology	5
ZOO 3605	Chordate Embryology	5
PCB 4044	General Ecology	5
PCB 4745	Animal Physiology	5
ZOO 3513	Animal Behavior	5
ZOO 4404	Integrated Marine Biology	6
ZOO 4926	Special Topics - Marine Benthic Communities and Oceanographic Practicum	3
ZOO 4905	Individual Studies in Zoology	4

GRADUATE COURSES

PCB 6356	Ecosystems of Tropics	4
BOT 6576	Photophysiology of Plant Growth	4
BOT 6646	Ecology of Aquatic Plants	5
BOT 6666	Advanced Tropical Botany	12
BOT 6951	Tropical Biology: An Ecological Application	12
EOC 6169	Littoral Processes	4
EOC 6430	Coastal Structures I	4
EOC 6431	Coastal Structures II	4
EOC 6850	Simulation Techniques	4
EOC 6905	Individual Study in Coastal and Oceanographic Engineering	1-9
EOC 6910	Supervised Research	1-5
EOC 6932	Selected Field and Laboratory Problems	3-8
EOC 6934	Advanced Topics in Coastal and Oceanographic Engineering	1-6
EOC 6939	Graduate Seminar	1
EOC 6940	Supervised Teaching	1-5
EOC 6971	Research for Master's Thesis	1-15
GLY 6250	Mineralogy of Clays	4
GLY 6574	Fluvial, Deltaic and Transitional Environments of Sedimentation	4
GLY 6575	Coastal and Estuarine Geology	4
GLY 6660	Paleoecology	4
GLY 6705	Geomorphology of Southeastern U.S.	4
OCG 6276	Geological Oceanography I	4
OCP 6056	Physical Oceanography	4
OCP 6165	Ocean Waves I: Linear Theory	4
OCP 6167	Ocean Waves II: Nonlinear Theory	4
OCP 6169	Ocean Wave Spectra	4
OCP 6295	Estuarial Hydromechanics and Engineering I	4
OCP 6296	Estuarial Hydromechanics and Engineering II	4
OCP 6297	Estuarial Hydromechanics and Engineering III	4
OCP 6555	Air-Sea Interaction I: Microscale	4
OCP 6556	Air-Sea Interaction II: Macroscale	4
ZOO 5405	Biology of Marine Animals	5
ZOO 5317	Marine Ecology	5
ZOO 5487	Analytical Techniques in Marine Ecology	2
PCB 6049	Seminar in Ecology	2
PCB 6447	Community Ecology	5
ZOO 6207	Advanced Invertebrate Zoology	5
ZOO 6336	Principles of Systematic Zoology	4
ZOO 6456	Icthyology	5
ZOO 6506	Ethology	4
ZOO 6816	Zoogeography	3
ZOO 6857	Advanced Studies in Zoology	12
ZOO 6905	Individual Studies in Zoology	1-5
ZOO 6927	Special Topics in Zoology:	
	Coral Reef Ecology	4
	Marine Benthic Communities	4
	Marine Invertebrate Embryology	4
	Behavior and Ecology of Marine Larvae	4
	Oceanographic Practicum	4
	Selected Topics in Marine Ecology	4

The instructional staff for the courses listed above includes the following:

BOTANY

Anthony, D.S., Ph.D., Professor
Davis, J.S., Ph.D., Professor
Ewel, J.J., Ph.D., Associate Professor
Griffin, D.G. III, Ph.D., Associate Professor
Hodgson, L.M., Ph.D., Assistant Research Scientist
Humphreys, T.E., Ph.D., Professor
Judd, W.S., Ph.D., Assistant Professor
Kimbrough, J.W., Ph.D., Professor
Lucansky, T.W., Ph.D., Associate Professor
Lugo, A.E., Ph.D., Associate Professor
Mullins, J.T., Ph.D., Professor

Shanor, L., Ph.D., Professor
Smith, R.D., Ph.D., Professor
Vasil, I.K., Ph.D., Professor
Ward, D.B., Ph.D., Professor

COASTAL ENGINEERING

Chiu, T.Y., Ph.D., Professor
Gondeck, A.R., Ph.D., Assistant Engineer
Mehta, A.J., Ph.D., Assistant Professor
Ochi, Michael, Ph.D., Professor
Partheniades, E., Ph.D., Professor
Shemdin, O.H., Ph.D., Associate Professor
Sheppard, D.M., Ph.D., Assoicate Professor
Wang, Y.H., Ph.D., Associate Professor

GEOLOGY

Eades, J.L., Ph.D., Associate Professor
Griffin, G.M., Jr., Ph.D., Professor
Kuhnhenn, G.L., Ph.D., Assistant Professor
MacFadden, B.J., Ph.D., Assistant Professor
Mueller, P.A., Ph.D., Associate Professor
Pierce, R.W., Jr., Ph.D., Associate Professor
Pirkle, E.C., Jr., Ph.D., Professor
Randazzo, A.F., Ph.D., Professor
Ridge, J.D., Ph.D., Adjunct Professor
Shaak, G.D., Ph.D., Assistant Professor
Smith, D.L., Ph.D., Associate Professor
Spangler, D.P., Ph.D., Associate Professor
Wahl, F.M., Ph.D., Professor
Webb, S.D., Ph.D., Professor

ZOOLOGY

Ache, B.W., Ph.D., Associate Professor
Anderson, J.F., Ph.D., Associate Professor
Berner, L., Ph.D., Professor
Bloom, S.A., Ph.D., Assistant Professor
Brockman, H.J., Ph.D., Assistant Professor
Brodkorb, P., M.D., Professor
Carr, A.G., Jr., Ph.D., Graduate Research Professor
Carr, W.E.S., Ph.D., Professor
Deevey, G.C., Ph.D., Adjunct Professor
DeWitt, R.M., Ph.D., Associate Professor
Eisner, T., Ph.D., Graduate Research Professor
Emmel, T.C., Ph.D., Professor
Feinsinger, P., Ph.D., Assistant Professor
Giesel, J.T., Ph.D., Associate Professor
Gilbert, C.R., Ph.D., Associate Professor
Johnson, F.C. II, Ph.D., Professor
Johnston, D.W., Ph.D., Professor
Kaufmann, J.H., Ph.D., Professor
Lanciani, C.A., Ph.D., Associate Professor
Maturo, F.J.S., Ph.D., Professor
McNab, B.K., Ph.D., Professor
Nicol, D., Ph.D., Professor
Nordlie, F.G., Ph.D., Professor
Reisking, J., Ph.D., Associate Professor
Schwassmann, H.O., Ph.D., Associate Professor
Walbrunn, H.M., Ph.D., Associate Professor
Westfall, M.J., Jr., Ph.D., Professor
Wolff, R.G., Ph.D., Assistant Professor

SEA GRANT

Aska, D.A., B.S., Marine Specialist
Clarke, M.L., Ph.D., Marine Advisory Program Coordinator
Leahy, T., M.S., Editor
Popenoe, H.L., Ph.D., Sea Grant Director
Seaman, W., Ph.D., Sea Grant Assistant Director

To obtain further information, address inquiries to:

Director
Center for Aquatic Studies
2001 McCarty Hall
University of Florida
Gainesville, Florida 32601

UNIVERSITY OF GEORGIA

Athens, Georgia 30602

At the University of Georgia faculty members in several departments, including Botany, Zoology, Microbiology, and Geology, are actively involved in marine research and offer marine-oriented courses. However, the University of Georgia does not offer a degree in marine biology, marine ecology, oceanography, or other fields of marine science at either the undergraduate or graduate level.

Students interested in attending the University of Georgia to pursue marine sciences may apply for admission to the department of their primary interest. Another option available for students interested in a Ph.D. degree in marine ecology is the Ecology Degree Program, an interdisciplinary program established several years ago to provide students with an opportunity to obtain the Ph.D. degree outside of the traditional department mode.

Faculty members who participate in marine research and education at the University of Georgia and the University System's Skidaway Institute of Oceanography comprise a Marine Sciences Faculty. Representation in this Marine Sciences Faculty presently includes the University of Georgia's Marine Institute on Sapelo Island and Marine Extension Service at Brunswick and Savannah, the Department of Botany, Zoology, Microbiology, and Geology, and the Skidaway Institute of Oceanography at Savannah.

The University of Georgia's coastal facilities include the Marine Institute on Sapelo Island, the Marine Resources Center on Skidaway Island, and the Fisheries Extension Station at Brunswick. Also located on Skidaway Island is the University System's research facility, the Skidaway Institute of Oceanography.

The Marine Institute is located on the southern end of Sapelo Island. Primarily a research facility, it is involved mainly with marsh ecological research. Current interests are focused on energy flow in the marsh ecosystem, cycling of materials and nutrients through the marshes, and factors regulating the metabolism of the marsh ecosystem. A staff of 36 scientists, technicians, and support personnel is in residence throughout the year. The Marine Institute also serves as a research site for faculty members and graduate students based on the main campus of Athens. Formal courses are not offered at the Marine Institute. Physical facilities of the Marine Institute include several laboratory buildings, residences, trailers, dormitories, dining hall, boat house and maintenance shops. The Institute operates the 44-foot Spartina and other small boats.

The Marine Resources Center is located on Skidaway Island, outside of Savannah. Since 1973 it has served as the major site in the State for marine educational programs designed to supplement the needs of pre-college, undergraduate and graduate level classes. The building has aquarium facilities for exhibiting live specimens common to Georgia coastal waters, other instructional exhibits, seminar and lecture rooms, and laboratories with running seawater. Dormitory and dining facilities are available. A staff of 20 including scientists, technicians, and support personnel is in residence.

Courses are offered for college credit in the summer through participating institutions in the University System of Georgia. Information concerning summer courses can be obtained from the Marine Sciences Program, Ecology Building, University of Georgia, Athens, Georgia 30602.

From September to June, the Center serves as a field station for schools and colleges in Georgia where teachers can bring their science classes to obtain direct experience with the marine environment.

The Fisheries Extension Center, with a staff of 17 is located at Brunswick. It assists the seafood industry, including fishermen and processors, and other marine-related industries to increase their efficiency and capabilities through programs of applied research, advisory services, and training. The Brunswick area is a major site for the shrimp industry in Georgia. The Fisheries Center operates the 57-foot shrimp boat, Captain Gene, to provide training, to carry on gear research, and to conduct resource assessment studies.

A major effort of the Fisheries Center is to provide advisory assistance to the seafood processing industry in regard to seafood waste disposal, quality control, and in-plant sanitation.

The Skidaway Institute of Oceanography serves as a marine research facility for the University System. The Skidaway Institute and the University of Georgia's Marine Resources Center are located on the northern end of Skidaway Island.

A staff of 75 scientists, technicians, and support personnel are in residence. The Institute operates the R/V Bluefin, a 75-foot shrimp boat modified for coastal oceanographic research, 42-foot Morgan J., 65-foot Kit Jones, and a number of small boats.

Research interests are focused on the continental shelf and include studies of phytoplankton, zooplankton, and benthos, and physical, chemical and geological oceanography. Another major effort is devoted to the study of pollutants (petroleum, heavy metals) in marine waters.

The Skidaway Institute does not offer courses or degrees, but many of its staff members hold adjunct appointments at the University of Georgia, Georgia Institute of Technology, and Georgia Southern. They participate actively in the summer teaching program, and serve as major advisors to graduate students from various universities and colleges.

The following courses are offered in conjunction with the above program. Advanced courses that are wholly or in part marine in aspect are listed by department. Courses numbered 800 or above are strictly graduate; the others are senior-graduate.

DEPARTMENT OF BOTANY

610	Biology of the Algae I	5
832	Biology of Phycomycetes	5
860	Aquatic Plants	5
862	Marine Botany	5

DEPARTMENT OF GEOLOGY

303	Elementary Oceanography	5
603	Invertebrate Paleontology	5
605	Sedimentation and Stratigraphy	5
609	Marine Geology	5
612	Palynology	5
615	Applied Oceanography	5
630	Clay Mineralogy	4
641-643	Introduction to Research in Oceanography	5
645	Geochronology and Isotope Geology	5
651	Micropaleontology	5
652	Introduction to Paleoecology	5
660	Solid Earth Geophysics	5
811	Petrography and Petrology of Sedimentary Rocks	3
815	Special Problems in Sedimentology and Oceanography	5
825	Plate Tectonics	3
830	Marine Ecology and Taphonomy	5
831	Coastal Geology of Southeastern U.S. (Skidaway)	5

DEPARTMENT OF MICROBIOLOGY

662	Microbial Ecology	5
860	Physiology of Bacteria	5

DEPARTMENT OF ZOOLOGY

605	Ichthyology	5
607	Invertebrate Zoology I	5
608	Invertebrate Zoology II	5
660	Marine Biology	5
800	Ecological Energetics	5
810	Limnology and Oceanography	5
811	Biological Oceanography	5
813	Seminar in Hydrobiology	1
816	Marine Ecology	5
855	Population Ecology	5
858	Systems Ecology I	3
859	Systems Ecology II	3
868	Systems Ecology: Dynamic Analysis I	5
869	Systems Ecology: Dynamic Analysis II	5
856	Ecology Seminar	1
857	Pollution Ecology	5

The instructional staff for the courses listed above consists of the following:

BOTANY

Darley, W. Marshall, Ph.D., Associate Professor
Fuller, Melvin S., Ph.D., Professor
Porter, David, Ph.D., Associate Professor

GEOLOGY

Carver, Robert E., Ph.D., Associate Professor

Ellwood, Brooks B., Ph.D., Assistant Professor
Frey, Robert W., Ph.D., Professor
Hurst, Vernon J., Ph.D., University Research Professor
Ledbetter, Michael T., Ph.D., Assistant Professor
Noakes, John E., Ph.D., Associate Professor
Sen Gupta, Barun K., Ph.D., Professor
Wenner, David B., Ph.D., Associate Professor

MICROBIOLOGY

Finnerty, William R., Ph.D., Professor
Hodson, Robert E., Ph.D., Assistant Professor
Patton, John S., Ph.D., Assistant Professor
Wiebe, William J., Ph.D., Professor

ZOOLOGY

Chin, Edward, Ph.D., Professor
Glasser, John W., Ph.D., Assistant Professor
Meyer, Judith L., Ph.D., Assistant Professor
Odum, Eugene, Ph.D., Alumni Foundation Professor
Patten, B.C., Ph.D., Professor
Pomeroy, L.R., Ph.D., Alumni Foundation Professor
Porter, James W., Ph.D., Associate Professor
Porter, Karen G., Ph.D., Adjunct Associate Professor
Scott, Donald C., Ph.D., Professor
Thomas, Grace J., Ph.D., Associate Professor
Wiegert, Richard G., Ph.D., Professor

MARINE EXTENSION SERVICE (Brunswick)

Bough, Wayne A., Ph.D., Associate Director
Gates, Keith, B.S., Research Coordinator I
Harrington, D.L., B.S., Marine Fisheries Specialist
Perkins, Brian E., M.S., Marine Resources Specialist II
Scott, Paul, Marine Resources Specialist I
Whitted, James, Marine Resources Specialist
Wu, C.M. Arnold, Ph.D., Assistant Marine Scientist

MARINE EXTENSION SERVICE (Skidaway Island)

Gillespie, David, Ph.D., Director of Education
Graves, J. Simmons, A.B., Research Technician III
Harding, James L., Ph.D., Director
Hon, Will, B.S., Marine Education Specialist
Jacobs, L. Anthony, Marine Resources Specialist I
Katzif, Samuel D., A.B., Research Technician III
Miller, David M.S., Curator
Schlein, Peter F., Assistant Curator

MARINE INSTITUTE (Sapelo Island)

Gallagher, John L., Ph.D., Associate Marine Scientist
Haines, Evelyn B., Ph.D., Assistant Marine Scientist
Hopkinson, Charles, Ph.D., Research Associate
Kinsey, Donald W., Ph.D. (pending), Director
Newell, Steven, Ph.D., Research Associate
Robertson, John Roy, Ph.D., Research Associate
Whitney, David E., Ph.D., Research Associate

SKIDAWAY INSTITUTE OF OCEANOGRAPHY (Skidaway Island)

Atkinson, L., Ph.D., Associate Professor
Blanton, Jackson O., Ph.D., Associate Professor
Hanson, Roger B., Ph.D., Assistant Professor
Henry, Vernon J., Ph.D., Professor of Geology (UGA)
Howard, James D., Ph.D., Professor
Lee, Richard F., Ph.D., Associate Professor
McConnell, Oliver J., Ph.D., Research Associate
Menzel, David W., Ph.D., Director
Paffenhofer, G.A., Ph.D., Associate Professor
Tenore, Kenneth R., Ph.D., Associate Professor
Wallace, Gordon T., Ph.D., Assistant Professor
Windom, Herbert, Ph.D., Professor
Yoder, James, Ph.D., Research Associate

To obtain further information, address inquiries to:

Graduate Coordinator
(Department of Interest)
University of Georgia
Athens, Georgia 30602

UNIVERSITY OF GUAM
Agana, Guam 96910

The University of Guam Marine Laboratory has research and teaching facilities located on the shores of Pago Bay adjacent to the main campus.

The 19,000 square-foot research building provides research and teaching laboratories and offices and features a flowing-seawater system. The 3,300 square-foot technical building provides workshop facilities and maintenance and storage space. Fourteen, 18 and 21-foot boats are available for near-shore and reef studies, which are the main emphasis of the laboratory. Research equipment includes oxygen and pH meters, specificion probes, spectrophotometers, microscopes, photographic equipment, diving gear, and a variety of field sampling gear. More sophisticated laboratory equipment, including an atomic absorption spectrophotometer and a gas chromatograph are available in other research laboratories on the main campus. Extensive reference and research collections, containing several thousand species of plants and animals, are available. The University publishes the journal Micronesica, devoted to the natural sciences of Micronesia and related areas.

The following degree is offered:

M.S. in Biology with an emphasis available in tropical marine biology.

a) Thirty graduate credits, including Biometrics, Biological Literature and Writing, and six hours of thesis research.

b) Comprehensive oral examination.
c) Completion of thesis and oral defense.

Four degrees were awarded during 1978-1979.

The following marine-oriented courses are offered in conjunction with the above program:

UNDERGRADUATE COURSES

BI 212	Oceanology	3

GRADUATE COURSES

BI 440G	Ichthyology	4
BI 510	Marine Biogeography	3
BI 512	Nutrient and Energy Flow in Marine Ecosystems	4
BI 516	Morphology of Coral Reefs and Coral Systematics	3
BI 517	Species Interactions in Marine Systems	3
BI 518	Physiological Ecology of Aquatic Organisms	4
BI 546	Marine Invertebrates	4
BI 547	Fisheries Biology	4
BI 574	Marine Botany	4
BI 690	Special Projects	1-3
BI 691	Seminar	1
BI 695	Thesis Research	6

The instructional staff for the courses listed above consists of the following:

MARINE LABORATORY

Amesbury, Steven S., Ph.D., Assistant Professor
Birkeland, Charles E., Ph.D., Associate Professor
Eldredge, Lucius G., Ph.D., Professor
Marsh, James A., Jr., Ph.D., Associate Professor
Nelson, Stephen G., Ph.D., Assistant Professor
Randall, Richard H., M.S., Assistant Professor
Tsuda, Roy T., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. Steven S. Amesbury, Coordinator
Graduate Program in Biology
Marine Laboratory
University of Guam
P. O. Box EK
Agana, Guam 96910

UNIVERSITY OF HAWAII
Honolulu, Hawaii 96822

Hawaii's unique location in the Pacific Ocean makes it inevitable that a marine orientation will appear in some aspect of all man's activities in these islands. The University of Hawaii, recognizing this all-encompassing orientation, has structured its marine programs to insure that students in all disciplines have an opportunity to share fully in the marine resources of the university and the state. Hawaii's natural setting, with beaches, coral reefs, and easy access to the open ocean, and its numerous marine-oriented organizations, combine with the university facilities to provide an unusual opportunity for marine studies.

No single college or department of the university has sole responsibility for marine curricula. Under the direction of the Dean of Marine Programs, there is a university-wide focus on marine activities. Marine interests involve the departments of botany, zoology, geology and geophysics, agriculture and resource economics, architecture, history, and biochemistry and biophysics, among others, in the College of Arts and Sciences. Other marine-related programs and curricula can be found in the School of Law, the School of Medicine, the College of Engineering, and the College of Tropical Agriculture.

An undergraduate marine non-degree program, the Marine Option Program, offers students from any major field of study the opportunity to acquire a marine orientation during the pursuit of the baccalaureate. Several marine-related research institutions function both on and off campus, including the Hawaii Institute of Geophysics, Pacific Biomedical Research Center, Look Laboratory of Ocean Engineering, Environmental Center, Water Resources Research Center, and the Hawaii Natural Energy Institute. Although some departments have a greater marine orientation than others, there is no section of the university untouched by marine influences.

THE SEA GRANT COLLEGE PROGRAM

Hawaii's Sea Grant College Program is multi-disciplinary and multi-focused and addresses a wide spectrum of concerns the state sees as immediate and vital to the well-being of its marine environment. Undergirding Sea Grant activities is the knowledge that Hawaii, because of its unique mid-ocean location, has access to vast resources which need to be studied and developed without harmful disruption of the marine ecosystem in which such resources are found. Marine research and development in Hawaii are as yet largely areas of discovery. As relevant and real needs within the state become identified, they will become concerns of the Sea Grant College Program at the University of Hawaii. Current Sea Grant acitivities encompass projects in marine resources development, socio-economic and legal studies, marine technology research and development, marine environmental research, marine education and training, and extension service.

The education and training mission of the Sea Grant College Program provides support for development of curricula at all the appropriate levels in the University system. Courses and programs which have received or can receive Sea Grant support include marine technician training, aquaculture, marine agronomy, ocean engineering, the humanities, and other marine instructional related activities.

UNIVERSITY MARINE FACILITIES AND INSTITUTES

Ship Operations - J. Frisbee Campbell, Scientific Coordinator

The university operates two large oceanographic research vessels from the University Marine Center at Pier 45: R/V Kana Keoki (156 feet) and R/V Moana Wave (175 feet). A smaller vessel, R/V NOII (65 feet) is used to provide instruction in oceanographic research for undergraduate students of the university and community colleges and high school students, as well as for instrument testing.

Waikiki Aquarium - Leighton R. Taylor, Director

The Waikiki Aquarium is a state-owned museum specializing in Hawaiian aquatic exhibits. It is located in Waikiki and is operated by the University of Hawaii as a place for the education and recreation of Hawaii's residents and visitors.

Makapuu Research Pier - Henry M. Horn, Acting Manager

Located at Makapuu, Oahu, the Makapuu Pier has offices, warehouse space, and research facilities. Equipment includes submersibles (currently used for precious coral research and harvesting); the Aegir, an underwater habitat used in diving physiological research; a Deck Decompression Chamber; and related hardware and software necessary for man-in-the-sea research.

HAWAII INSTITUTE OF GEOPHYSICS (HIG) - Dr. Charles E. Helsley, Director

Adams, W. Mansfield, Seismology
Ahana, Asami, Administrative Officer I
Andrews, James, Associate Professor
Andrews, Katherine, Technician
Balogh, John, Mechanical Engineer I
Barnett, Irvin, Petrographic Thin Section Technician
Barrett, David, Engineer I
Blackinton, Grant, Design Engineer
Berg, Eduard, Geophysicist
Brown, Ruth Anna, Administrative Officer
Buddemeier, Robert, Associate Professor
Byrne, David, Engineering Support Facility Coordinator
Campbell, John Frisbee, Research Associate IV
Chave, Keith, Professor
Cooney, Thomas, Manager
Cote, Raymond, Senior Electronic Technician
Cuddy, David, Technician and Computer Programmer
Cunningham, Robert, Programmer/Analyst
Dang, Steven, Instrument/Data Technician
Duennebier, Frederick, Research Scientist-Seismology
Epp, David, Research Geophysicist
Erlandson, Dale, Data Analysis Technician
Fan, Pow-Foong, Associate Professor
Fisher, Edward S., Research Affiliate
Fraley, Charles, Research Associate
Fryer, Gerard, Research Associate
Fujisawa, Thelma, Administrative Assistant
Furumoto, Augustine, Seismologist and Professor
Gallagher, Brent, Associate Professor
Garcia, Michael, Assistant Professor
Gavenda, William F., Jr., Electronics Technician II
Gettrust, Joseph, Research Geophysicist-Seismology
Godley, Valerie, Research Associate III
Greenberg, Virginia, Research Associate III
Groves, Gordon, Professor
Gust, Giselher, Visiting Assistant Professor
Hammond, Stephen, Research Scientist-Geophysicist
Hamaraki, Constance, Technician I
Harris, David, Electronic Engineer
Harris, Frederick A., Associate Physicist
Hey, Richard, Research Scientist-Marine Magnetics
Hingston, Lora, Secretary
Hiraki, Kenneth, Electronic Techician I
Houlton, Edward, Communication Supervisor
Hurd, David, Associate Oceanographer
Hussong, Donald, Associate Geophysicist
Ichinose, William, Electronic Engineer I
Ishihara, Marjorie, Accounting Clerk III
Jeffcott, Raymond, Marine Technician
Jubinski, Paul, Supervisor Shipboard-Computer Facility
Kajiwara, Jane, Secretary V
Katahara, Keith, Research Associate
Keating, Barbara, Assistant Geophysicist
Khan, Mohammed, Professor
Kilonsky, Bernard, Computer Programmer, Data Manager
Koyanagi, Carol, Clerk Steno III
Kroenke, Loren, Associate Geophysicist
Kroopnick, Peter, Associate Professor
Larson, Jimmy C., Research Affiliate
Latreille, Sharon, Seismological Research Technician
Laurila, Simo, Professor
Lavin, Ralph, Scientific Illustrator I
Lomnitz, Cinna, Research Affiliate
Longfield, Richard L., Assistant Director
Lukas, Roger, Research Associate
Magaard, Lorenz, Professor
Malahoff, Alexander, Research Affiliate
Manghnani, Murli, Geophysicist
Mansfield, Karen, Data Technician
Margolis, Karen, Lab Technician
Margolis, Stanley, Associate Professor
Mason, Ronald, Research Affiliate
Mato, Christine, Lab Assistant
Mato, George, Administrative Officer III
Mattes, Hubert, Scientific Instrument Maker II
Maynard, Sherwood, Research Technician
McCreery, Charles, Research Associate I
McKay, Monica, Computer Programmer/Operator
Meloy, Ann, Supervisor, Data Processing Facility
Michel, Jean, Electronic Engineer I
Ming, Li-chung, Research Scientist
Mitiguy, Robert, Instrumentation Technician
Miyamoto, Brent, Data Processor
Moberly, Ralph, Professor and Chairman
Moore, Dennis W., Research and Professor of Oceanography
Murphy, Ted, Research Associate II
Nakahara, Shikiko, Computer Programmer
Naughton, John, Chemist
Nelson, Jan, Lab Assistant
Noble, Clyde, Mass-Spectrometrist Geochemist
Oshiro, Karen, Secretary III
Pankiwskyj, Kost, Associate Professor
Parvulescu, Antares, Professor of Ocean Engineering
Philpotts, John, Associate Geochemist
Pozzi, Pierluigi, Assistant in Geophysics
Pujalet, Rita, Editor IV
Rai, Chandra, Assistant Geophysicist
Redalje, Donald, Research Associate
Redalje, Randi, Lab Assistant
Rehbock, Karen, Administrative Assistant
Resig, Johanna, Associate Researcher
Rhodes, Richard, Graphic Artist III
Rose, John, Geophysicist
Rowell, Unni, Educational Specialist II
Russ, Price, Assistant Professor
Ryan, Michael P., Assistant Professor
Schlabach, David, Electronic Technician II
Schlanger, Seymour O., Professor
Schuhmann, Shufford, Mass-Spectrometrist
Simpson, Michael, Computer Programmer
Sinton, John M., Assistant Professor
Sklarz, Michael, Computer Programmer
Soroyama, Joanne, Clerk Steno II

Stalb, Douglas, Scientific Photographer
Stroup, Edward, Associate Professor and Chairman
Sunn, Alvin, Stable Isotope Lab Manager
Sutton, George H., Professor
Taga, Jean, Clerk Steno III
Tamura, Sue, Research Assistant
Terry, Kenneth, Research Associate
Theyer, Fritz, Research Scientist
Thomas, Donald, Research Scientist
Thompson, Noel, Electronic Engineer I
Van Devender, Susan, Secretary
Veeh, Hans Herbert, Research Affiliate
Vitousek, Martin, Specialist in Geophysics
Walker, Daniel, Associate Seismologist
Wilson, Douglas, Data Technician
Wolfe, James, Technician
Woodcock, Alfred H., Research Affiliate
Woollard, Bruce, Technician
Wong, Diana, Research Assistant
Wright, Peter, Assistant Researcher-Oceanographer
Wyrtki, Klaus, Professor
Yagawa, Francine, Data Processor
Yasui, Carol, Administrative Assistant
Yee, Karena, Clerk-Typist
Yeh, Hsueh-Wen, Assistant Geochemist
Yokogawa, Sharon, Computer Programmer
Young, Richard, Associate Professor

The HIG conducts geological, geochemical, and geophysical research in the broad field of the earth sciences. Programs embrace research and advanced training in geodesy, marine geology and geophysics, physical oceanography, solid earth geophysics, geology, geochemistry, underwater acoustics, and tsunamis. The Institute maintains a twin-engine PBY-type aircraft and a seismograhpic observatory.

HAWAII INSTITUTE OF MARINE BIOLOGY -
Dr. John Caperon, Director

The Hawaii Institute of Marine Biology, an administrative unit under Organized Research of the University of Hawaii, provides research facilities for use by faculty with research programs, graduate students with thesis research, visiting scientists, and inhouse research programs. It serves as a base for field trips for courses in marine sciences of the University. Research programs include studies in the ecology, physiology, behavior and systematics of marine animals and plants, pollution studies, biology, chemistry and pharmacology of toxic marine organisms, fundamental research in the interrelationship of organisms and their environment, and other varied research activities.

The Institute is about 17 miles from the University of Hawaii campus, situated on a small island (Coconut Island) in Kaneohe Bay. There are shop and maintenance facilities, a machine shop, a small dark room, a computer room with time sharing equipment, analytical services, stenographic services. There is a 40-foot diesel boat with winch and A-frame and a 28-foot inboard diesel boat, plus a number of 13-foot and 16-foot Boston Whalers.

The Institute does not grant degrees, but provides research facilities for graduate students of the University of Hawaii.

To obtain further information, address inquiries to:

Dr. John Caperon, Director
Hawaii Institute of Marine Biology
P. O. Box 1346
Kaneohe, Hawaii 96744

THE J.K.K. LOOK LABORATORY OF OCEANOGRAPHIC ENGINEERING - Mr. T. John O'Brien, Director

Bathen, Karl H., Ph.D., Associate Researcher in Ocean Engineering
Bretschneider, Charles L., Professor of Ocean Engineering
Furuto, Gordon T., Technician
Gerritsen, Franciscus, Professor of Ocean Engineering
Ho, Henry F., Technician
Lee, Theodore T., M.Sc., Researcher in Ocean Engineering
Palmer, Robert Q., Associate Researcher in Ocean Engineering
Seidl, Ludwig H., Associate Professor of Ocean Engineering
St. George, A. John, Technician

The Look Lab conducts experimental research on hydraulic engineering problems related to structures in and physical characteristics of the coastal zone and deeper ocean. It also researches physiological problems related to human performance in the sea. Laboratory facilities include water wave tanks and hyperbaric facilities, as well as an 18-foot runabout. The laboratory is part of the department of Ocean Engineering.

HAWAII COOPERATIVE FISHERY RESEARCH UNIT -
Dr. James D. Parrish, Leader

The Hawaii Cooperative Fishery Research Unit promotes graduate training and research in fishery biology by providing students with support, counseling, and facilities. It functions as part of the department of zoology. The research program centers on fishery biology and ecology of inshore marine and inland waters. The unit operates under joint sponsorship of the university, the Hawaii Department of Land & Natural Resources and the U.S. Fish & Wildlife Service.

THE PACIFIC BIOMEDICAL RESEARCH CENTER -
Dr. Frederick Greenwood, Director

Allen, Richard D., Associate Professor of Microbiology
Arnold, John M., Ph.D., Associate Zoologist
Batkin, Stanley, Professor of Surgery
Chung, Chin Sik, Professor of PH and Genet.
Gibbons, Allan, Administrative Officer
Gibbons, Ian, Ph.D., Professor of Biophysics
Hadfield, Michael G., Ph.D., Assistant Zoologist
Hanna, Joel M., Assistant Professor of Anthropology
Hayashi, Edwin M., Technician
Hong, Suk Ki, Professor of Physiology
Humphreys, Tom D., Associate Professor of Biochemistry
Kane, Robert E., Ph.D., Associate Director
Klemmer, Howard W., Ph.D., Microbiologist
Norton, Ted R., Professor of Pharmacology
Palumbo, Nicholas, Professor of Comparative Medicine

Perri, Sam, Research Associate
Rand, David, Research Associate
Setliff, James A., Jr., Researcher in Physiology and Pharmacology
Smith, Richard M., Assistant Professor of Physiology
Szekerczes, Joseph, Research Associate
Ueno, Marilyn, Jr. Microbiologist
Whittow, G. Causey, Professor of Physiology

The PBRC encourages investigations in the areas of subcellular biology, microbiology, cell structure and function, regulatory biology, genetics, behavioral sciences, epidemiology, and other areas of medical research. Its building provides space; research equipment, such as electron microscopes; and research facilities, such as an animal colony, to faculty members, graduate students and visiting scientists. The center contains research laboratories for microbiology, physiology, biochemistry, biophysics, and psychology, in which it fosters and facilitates research projects of biomedical interest. It also maintains the Kewalo Marine Laboratory at Kewalo Basin.

CENTER FOR ENGINEERING RESEARCH - Dr. Charles S. Chen, Director

Kamiya, Mary, Research Associate
Shimabukuro, Elaine, Specialist

The Center for Engineering Research encourages development of new engineering research programs and provides technical and administrative support to existing projects. The center provides complete services for preparation of proposals and research reports. It participates in the planning, support services and operation of conferences, symposia and workshops. It keeps up-to-date records of all proposals and active research grants and contracts.

The center activities include research in structural engineering, transportation engineering, earthquake engineering, water resources, waste water treatment and disposal, geothermal energy, ocean thermal energy, fuels from biomass, wind energy, solar energy, theoretical mechanics, heat and mass transfer, materials science, coastal engineering, ocean structures, information theory, solid state devices, multi-processor computers and ionospheric dynamics. The center cooperates with other research organizations in joint research programs, particularly with the Hawaii Natural Energy Institute in energy related projects.

WATER RESOURCES RESEARCH CENTER - Dr. L. Stephen Lau, Director

Chang, Jen Hu, Ph.D., Climatologist
Chang, Williamson B.C., J.D., Law
Chun, Michael, Ph.D., Environmental Engineer
Davis, Dan, M.S., Research Affiliate
Dugan, Gordon, Ph.D., Environmental Engineer
Ekern, Paul C., Ph.D., Hydrologist
Fok, Yu-Si, Hydrologic Engineer
Fujioka, Roger, Ph.D., Associate Researcher
Gitlin, Harris, M.S., Agricultural Engineer
Green, Richard, Ph.D., Soil Scientist
Hufen, Theodorus, Ph.D., Geochemist
Kay, E. Alison, Ph.D., Marine Biologist
Loh, Philip, Ph.D., Virologist
Mink, John, M.S., Research Affiliate
Moncur, James E.T., Associate Economist
Peterson, Frank L., Ph.D., Hydrologist
Price, Saul, M.S., Research Affiliate
Russo, Anthony, M.S., Marine Biologist
Yamauchi, Hiroshi, Ph.D., Agricultural Economist
Young, Reginald H.F., Ph.D., Environmental Engineer

The WRRC plans and conducts research related to Hawaii's water resources, assists and promotes instruction in water resources in several academic departments, and provides for training opportunities of engineers and scientists through research. Research is interdisciplinary with a broad base of physical sciences, technology, ecology, and social sciences. It involves hydrology and hydraulic engineering and public health, climatology and soil physics, agricultural engineering and forestry, and socio-economic and legal aspects. The center operates research laboratories and field research facilities.

BEKESY LABORATORY OF NEUROBIOLOGY, PACIFIC BIOMEDICAL RESEARCH CENTER - Dr. Ian M. Cooke, Program Director

Bitterman, M.E., Ph.D., Comparative Psychology of Perception and Learning
Blanchard, Robert, Ph.D., Psychobiology
Cole, Robert E., Ph.D., Psychophysics of Human Vision
Cooke, Ian M., Ph.D., Cellular Neurophysiology; Electrophysiology of Neurosecretory Systems
Gillary, Howard L., Ph.D., Cellular Neurophysiology
Hartline, Daniel K., Ph.D., Cellular Neurophysiology
Rayner, Martin D., Ph.D., Membrane Biophysics

The Bekesy Laboratory of Neurobiology provides an intellectual and physical focal point for research on neuronal function at the University of Hawaii. The Laboratory carries on a broad program of basic research in the neurosciences including studies of the biophysics and chemistry of ionic channels in excitable membranes; cellular electrophysiological and morphological studies of neurosecretion; analysis and modeling of small neuronal systems and their integrative functioning; studies of neuronal control of emotional states; human pyschophysical studies of sensory perception; and comparative studies and theoretical modeling of learning processes. The research staff represents several disciplines including experimental and comparative psychology, neurophysiology, and biophysics. Experimental techniques include animal training, psychophysical testing, computer analysis and modeling, surgical and pharmacological intervention, and electrical stimulation and recording. Marine invertebrate preparations are widely used as model systems.

Twelve thousand square feet of space includes photographic darkroom, machine shop and electronics shop. Research equipment includes electronic equipment for electrophysiology, processing and analyzing low voltage signals, presentation and control of auditory and visual stimuli, and automatic programming of behavioral experiments.

Graduate students are formally associated with one of the academic departments in which members of the research staff hold appointments (physiology, psychology, zoology) although they are encouraged in their research to take advantage of the interdisciplinary character of the laboratory.

To obtain further information, address inquiries to:

Ian M. Cooke
Bekesy Laboratory of Neurobiology
1993 East-West Road
Honolulu, Hawaii 96822

UNDERGRADUATE PROGRAMS

Marine Option Program

Sponsored by the University of Hawaii and the University of Hawaii Sea Grant College Program, the multi-disciplinary Marine Option Program currently operates on the Manoa, Windward Community College, Maui Community College and Honolulu Community College campuses of the university system. MOP is designed to provide a marine orientation for undergraduates from any discipline. Students from more than 50 different majors have participated in MOP. Participation in MOP facilitates a smooth transition into marine-related graduate work or marine-related jobs. The academic requirements are: completion of a core-curriculum consisting of at least 12 credit hours including (a) Oceanography 201, (b) interdisciplinary study in a marine-related field (which may be met by either IS 261, 361, 461, or 463), and (c) six credit hours of study within the student's major or field of interest having a marine orientation. The student must also acquire a "marine skill" under a field practicum internship.

Marine Option Program student projects have included underwater tours of Hanauma Bay (now a major component of the state's tourist industry); the Blue-Water Marine Laboratory (a unique seagoing educational program for high school students); numerous baseline studies of the fish, algae, macroinvertebrates, and substrate in nearshore waters throughout the state; construction of an underwater pipeline for the Pacific Biomedical Research Center laboratory at Kewalo Basin; and working in all phases of research on human diving physiology.

Students have worked with fresh and salt water aquaculture projects at the Hawaii Institute of Marine Biology, Oceanic Institute, the state's Anuenue Fisheries Research Center, and the state's Aquaculture Development Program at the Department of Planning and Economic Development. Other students have worked on marine mammal training, physiology, and behavior as well as marine electronics and marine engineering at the Naval Ocean Systems Center in Kaneohe; at sea on oceanographic vessels from the National Oceanic and Atmospheric Administration, the University of Hawaii, Oregon State University, and Texas A&M University; in marine education programs in Hawaii, Florida, and the South Pacific and in many other marine activities.

BOTANY

Since the University of Hawaii is the only United States university within the tropics, its Botanical Sciences Program offers a unique opportunity for the study of tropical terrestrial and marine species in their environment. Hawaii also offers a unique ecological environment for the study of tropical plant diseases. Apart from the facilities on the Manoa campus, the College of Tropical Agriculture has research experiment station facilities on four islands with laboratories at branch stations on Hawaii, Kauai and Maui. These stations are at different altitudes and in different climatic zones.

Special activities associated with the botanical sciences program are a Sea Grant program in marine agronomy, a Resources Studies Unit of the National Park Service, and a plant disease clinic.

Special facilities at the University include the Hawaii Institute of Marine Biology for studies of marine algae and other marine plants and the Harold L. Lyon Arboretum for studies on tropical plants. The Botanical Sciences have recently moved into a new $4.5 million plant sciences building located on the Manoa campus. In addition to other facilities, this building houses a new Hitachi HS-8 electron microscope.

Arrangements for study may also be made with respective directors of the Honolulu Botanical Garden; the Bernice P. Bishop Museum which has extensive reference material and plant collections; the Pacific Tropical Botanical Garden; and the Hawaiian Sugar Planters' Association Experiment Station.

Graduate Degree Requirements

M.S. (Plan A -- thesis; Plan B -- nonthesis) and Ph.D. degrees in the botanical sciences are offered. At the discretion of a candidate and his/her committee, the degree may have the subtitle: Botanical Sciences (Plant Pathology). The M.S.--Plan A degree is intended for students pursuing research in botanical sciences as a profession and requires 12 credits for thesis work with a minimum of 18 additional credits for courses approved by the candidate's committee. The M.S.--Plan B degree emphasizes the technological aspects of the botanical sciences and requires 30 credits, 15 of which must be in the major field or an approved related field in courses numbered 600 or above. The Ph.D. degree in Botanical Sciences (besides other basic requirements) requires a dissertation which is to be an original contribution based on independent research.

UNDERGRADUATE COURSES

410	Plant Anatomy	3
410L	Plant Anatomy Laboratory	1
412	Microtechnique	3
430	Mycology	3
436	Medical Mycology	3
450	Natural History of the Hawaiian Islands	3
453	Plant Ecology and Environmental Measurements	4
454	Vegetation Ecology	4
461	Systematics of Vascular Plants	4
462	Plant Evolution	3
465	Bryophysics and Lichens	4
470	Principles of Plant Physiology	3
470L	Principles of Plant Physiology Laboratory	1
471	Photobiology	2
472	Photoperiodism in Plants	3
480	Phycology	3

GRADUATE COURSES

610	Botanical Seminar	1
612V	Advanced Botanical Problems	Variable
615	Morphology/Systematics Seminar	2
618	Cytology	3
619	Seminar in Biology Teaching	1
631	Marine Phytoplankton	3
640V	Environmental and Space Biology	Variable
650	Ecology Seminar	2
651	Marine Agronomics	3
662	Advanced Taxonomy	4
663	Plant Cytotaxonomy	2
665	Nomenclature Seminar	2
670	Plant Nutrition and Water Relations	3
671	Energetics and Biosynthesis in the Plant Kingdom	3
671L	Experiments in Phytochemistry	1
675	Physiology Seminar	1
676	Environmental Physiology Seminar	2
681	Seminar in Phycology - Chlorophyta	2
682	Seminar in Phycology - Phytoplankton	2
683	Seminar in Phycology - Myxophyta and Phaeophyta	2
684	Seminar in Phycology - Rhodophyta	2
699V	Directed Research	Variable

BOTANICAL SCIENCES (Bot Sci)

The graduate field of Botanical Sciences combines the resources of the departments of botany and plant pathology to offer programs leading to M.S. and Ph.D. degrees.

700V	Thesis Research	Variable
800V	Dissertation Research	Variable

The instructional staff for the courses listed above consists of the following:

Aobott, Isabella A., Ph.D., Wilder Professor of Botany
Doty, Maxwell S., Ph.D., Professor
Siegel, Sanford M., Ph.D., Professor

To obtain further information, address inquiries to:

Chairman
Department of Botany
University of Hawaii
3190 Maile Way
Honolulu, Hawaii 96822
(808) 948-8369

GEOLOGY AND GEOPHYSICS

The Department utilizes all available University research facilities, including the Hawaii Institute of Geophysics (HIG), the Water Resources Research Center, and the Environmental Center. Most faculty members hold joint appointments with the Department and one of the three institutes mentioned above. In addition to on-campus facilities, graduate students may also make use of such federal laboratories as the Hawaii Volcano Observatory (USGS), Marine Fisheries Laboratory (NOAA), Joint (with HIG) Institute for Marine and Atmospheric Research (NOAA), and the Honolulu Observatory (NOAA).

The education philosophy of the Department is that the study of the earth must draw on every related discipline for solution of the problems in earth science and that a good foundation in basic geology and closely related sciences is essential for advancing the frontiers of knowledge in studying the earth and its resources.

Graduate Degree Requirements

Both M.S. and Ph.D. degrees are awarded by the Department. For the M.S. degree, students must have completed work in exploration geophysics; tectonics; sedimentology, paleontology, geochemistry, or petrology; physical oceanography; and other coursework appropriate to his/her choosen specialization. In addition to the general requirements for an M.S. degree, students must have participated in work at sea or along the shore and have written a thesis. For the Ph.D. degree, students must have an M.S. degree or have done well on the M.S. General Examination. Although there are no formal course requirements for this degree, students generally prepare for the Ph.D. Comprehensive Examination by a combination of coursework and reading. Advanced students in geology and geophysics generally have additional experience along the coast or at sea. Most have also been chief scientists of research cruises before completing their dissertation.

The following courses are offered in conjunction with the above programs:

101	Introduction to Geology	3
101L	Introductory Geology Laboratory	1
102	General Geology and Geophysics	3
102L	General Geology Laboratory	1
130	Geological Hazards	3
140	Geology of the Earth's Resources	2
200	Geology of the Hawaiian Islands	3
300	Accelerated Introduction to Geology and Geophysics	4
301	Mineralogy	3
301L	Mineralogy Laboratory	2
302	Petrology	2
302L	Petrography	2
303	Structural Geology	3
305	Geological Field Methods	3
306	Work of Water	3
307	Sedimentology and Stratigraphy	3
316	Geomorphology	3
351	Earthquake Seismology and Engineering Hazards	3
360	Principles of Geophysics	3
361	Introduction to Geophysical Exploration Methods	4
399v	Directed Reading	Variable
407	Ore Deposits	3
651	Geomagnetism and Geoelectricity	2
652	Gravity	2
653	Solid State Geophysics	3
660v	Seminar in Solid-Earth Geophysics	Variable
672	Seminar in Geotectonics	3
674	Seminar in the Stratigraphy of the Ocean Basins	2
680v	Seminar in Geodesy	Variable
685	Adjustment Computation	3
699v	Directed Research	Variable
700v	Thesis Research	Variable
701	Physics of the Earth's Interior	3
702	Geophysical Instrumentation	3
703	Advanced Seismology	3
704	Numerical Methods in Geophysical Data Analysis	3
710	Selected Topics in Geology and Geophysics	2
711	Special Topics in Geology and Geophysics	3

731	Seminar in Structural Geology	2
733	Seminar in Igneous Petrology	2
734	Seminar in Metamorphic Petrology	2
735	Seminar in Geochemistry	2
800v	Dissertation Research	Variable

The instructional staff for the courses listed above consists of the following:

Adams, William, Ph.D., Professor
Berg, Eduard, Ph.D., Professor
Cox, Doak C., Ph.D., Professor and Director of the Environmental Center
Duennebier, Frederick K., Ph.D., Geophysicist (HIG)
Fan, Pow-foong, Ph.D., Associate Professor
Furumoto, Augustine S., Ph.D., Professor
Garcia, Michael O., Ph.D., Assistant Professor
Gettrust, Joseph, Ph.D., Geophysicist (HIG)
Hammond, Stephen R., Ph.D., Geophysicist (HIG)
Helsley, Charles E., Ph.D., Professor and Director of Hawaii Institute of Geophysics (HIG)
Hey, Richard N., Ph.D., Geophysicist (HIG)
Hussong, Donald M., Ph.D., Geophysicist (HIG)
Kroenke, Loren W., Ph.D., Geophysicist (HIG)
Manghnani, Murli H., Ph.D., Professor
Moberly, Ralph, Ph.D., Professor and Department Chairman
Peterson, Frank L., Ph.D., Professor
Philpotts, John A., Ph.D., Associate Professor
Resig, Johanna M., Dr. rer. nat., Associate Professor
Rose, John C., Ph.D., Professor
Ryan, Michael P., Ph.D., Assistant Professor
Schlanger, Seymour O., Ph.D., Professor
Sinton, John M., Ph.D., Assistant Professor
Sutton, George H., Ph.D., Professor
Theyer, Fritz, Ph.D., Paleontologist (HIG)

Affiliate Graduate Faculty (Scientists stationed in Hawaii, who assist academically at the University)

Davis, Dan A., United States Geological Survey
Lockwood, John P., United States Geological Survey
Loomis, Harold G., National Oceanic and Atmospheric Administration
Sheldon, Richard P., United States Geological Survey

To obtain further information, address inquiries to:

Chairman, Graduate Work Committee
Department of Geology and Geophysics
University of Hawaii
2525 Correa Road
Honolulu, Hawaii 96822

METEOROLOGY

Degree Requirements (Plan A only)

1. M.S. A minimum of 24 credit hours of coursework and six credit hours of thesis research. General and thesis examinations are required.

2. Ph.D. A reading comprehension of one foreign language with useful scientific literature in the field of the candidate. At some time during his first year of residence, the Ph.D. candidate may be required to pass a screening examination prerequisite to proceed toward a degree.

Intended candidates must present a thorough preparation in general physics, chemistry, and mathematics through calculus, as well as a minimum of 14 hours of undergraduate credit in meteorology including courses in climatology, instruments and observations, descriptive meteorology, and synoptic meteorology. Deficiencies in undergraduate preparation must be made up. Besides meteorology courses, courses may be allowed in the fields of oceanography, physics and mathematics.

The following courses are offered in conjunction with the above programs:

639	Meteorology of the Tropical Oceans	2
640	Advanced Tropical Meteorology Laboratory	3
641	Monsoon Meteorology	3
642	Cumulus Dynamics	3
643	Cloud Physics	3
644	Physical Meteorology	3
645	Advanced Air Pollution Meteorology	3
646	Statistical Meteorology	3
650	Advanced Theoretical Meteorology I	3
651	Advanced Theoretical Meteorology II	3
699	Directed Research	Variable
700	Thesis Research	Variable
742	Atmospheric Turbulence	3
745	Dynamic Meteorology in Extratropics	5
746	Dynamic Meteorology in Tropics	5
752	Special Topics in Meteorology	3
765	Seminar in Meteorology	Variable
800	Thesis Research	Variable

MICROBIOLOGY

648	Marine Microbial Ecology	3
697	Marine Microbiology	3
699	Directed Research	Variable
700	Thesis Research	Variable
800	Dissertation Research	Variable

OCEAN ENGINEERING

401	Introduction to Ocean Engineering	3
403	Fundamentals of Ocean Engineering	3
411	Buoyancy and Stability	3
412	Resistance and Powering of Ships	3
461	Coastal and Harbor Engineering I	3
601	Ocean Engineering Laboratory	3
603	Oceanography for Ocean Engineers	3
607	Wave Dynamics	3
608	Statistical Analysis of Waves	3
609	Principles of Ocean Engineering	3
612	Seakeeping	3
614	Ocean Hydrodynamics Laboratory	2
621	Introduction to Ocean Acoustics	3
622	Sonar System Engineering	3
623	Electroacoustics	3
631-632	Structural Design of Ocean Systems I and II	3
651	Instrumentation Seminar	2
652	Nearshore Marine Survey Techniques	3
662	Coastal and Harbor Engineering II	3
664	Sediment Transport, Littoral Drift and Dredging Technology	3
681	Ocean Systems	3
682	Design of Ocean Systems	3
683	Ocean Engineering Design Project	3
691	Special Topics in Ocean Engineering	Variable
692	Seminar in Ocean Engineering	Variable
694	Economics of Marine Resources	3
696	Topics in Ocean Engineering	1

699	Directed Reading or Research	Variable
800	Thesis Research	Variable

Graduate Faculty

Adams, C.W., M.S., Climatology, Physical Oceanography
Chiu, W.C., Ph.D., Theoretical and Statistical Meteorology
Daniels, P.A., Ph.D., Physical Meteorology, Atmospheric Pollution
Fullerton, C.M., Ph.D., Cloud Physics
Murakami, T., D.Sc., General Atmospheric Circulation, Numerical Methods
Ramage, C.S., D.Sc., Chairman of Meteorology, Tropical Meteorology
Sadler, J.C., M.S., Satellite Meteorology, Tropical Meteorology
Schroeder, T.A., Ph.D., Meso-Meteorology
Takahashi, T., Ph.D., Cloud Physics

Affiliate Faculty

Price, S., B.S., Physical Meteorology
Pyle, R.L., Ph.D., Satellite Meteorology

OCEANOGRAPHY

The University currently offers a master's and a doctoral program in physical, chemical, geological, and biological oceanography.

Intended candidate should have an undergraduate major in physics, chemistry, geology, geophysics, engineering, mathematics, biology, zoology, or botany. A minimum of one year of calculus, physics, and chemistry is required of all students prior to admittance. A minimum of one semester each of geology and biology are recommended as well. Graduate Record Examinations (advanced and aptitude) are required. Interested students should write to the department chairman for a brochure and further information.

Students pursuing a degree program must take the following courses or their equivalents: Ocean 620, 621, 622, 623. These and other background courses are usually taken in the first year. Subsequently the student specializes, depending on his/her disciplinary inclination. A Departmental Oral Exam is administered to all students, usually at the end of the first year of study. At this time the student may be admitted directly into the Ph.D. program, or may be required to work initially toward the M.S. degree.

All students must demonstrate qualification in digital computing, must accumulate (or have accumulated) at least one month of field experience, and must take at least one graduate seminar course in oceanography.

The M.S. program requires a minimum total of 30 credit hours, including 18 credits of coursework and 12 credits of thesis research.

Candidates for the Ph.D. must pass a comprehensive examination and a final oral examination in defense of the dissertation. They must qualify in one foreign language.

About 40% of marine scientists are employed by the U.S. Government, especially by the Departments of Defense, Commerce, and Interior. Another 40% teach and do research at academic institutions. About 20% are employed by industry.

Courses listed below are available for credit in the degree program. Additional courses may be selected from the fields of botany, chemistry, engineering, geology, mathematics, meteorology, physics, and zoology.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

201	Science of the Sea	3
230	Ocean Resources and Ecology	3
320	Aquatic Pollution	3

GRADUATE COURSES

620	Physical Oceanography	3
621	Biological Oceanography	3
622	Geological Oceanography	3
623	Chemical Oceanography	3
630	Physical Oceanography Laboratory	1
633	Chemical Oceanography Lab Methods	1
634	Techniques in Geological Oceanography	2
635	Radiochemistry and Nuclear Reaction	3
635L	Radiochemical Techniques	1
636	Phytoplankton Ecology	3
640	Advanced Physical Oceanography	3
641	Sedimentology I	3
642	Sedimentology II	3
643	Marine Geochemistry	3
646	Zooplankton Ecology	3
648	Marine Microbial Ecology	3
650	Mathematical Techniques for Biologists	3
660	Ocean Waves	3
661	Tides	3
662	Marine Hydrodynamics	3
663	Measurements and Instrumentation	3
664	Wave Propagation in Oceanography	3
665	Oceanic Turbulence I	3
666	Oceanic Turbulence II	3
667	Ocean Circulation Theories	3
672	Seminar in Geotectonics I	3
673	Continental Shelves	3
674	Seminar in the Stratigraphy of the Ocean Basins	2
697	Marine Microbiology	3
699	Directed Research	Variable
700	Thesis Research	Variable
702	Deep Sea Biology	3
705	Ecology and Management of Marine Resources	2
735	Seminar in Oceanography	2
750	Topics in Biological Oceanography	2
760	Topics in Physical Oceanography	Variable
770	Seminar in Chemical Oceanography	1
780	Seminar	1
800	Dissertation Research	Variable

The instructional staff for the courses listed above consists of the following:

Andrews, J.E., Ph.D., Seafloor Geology, Sediments, Manganese Nodules, Plate Tectonics
Bardach, J.E., Ph.D., Ocean Resource Policy, Aquatic Organism Physiology, Aquaculture
Caperon, J., Ph.D., Phytoplankton Ecology, Resource Management
Chave, K.E., Ph.D., Mineral-Seawater Interactions, Reefs
Clarke, T.A., Ph.D., Nekton Population Ecology
Gallagher, B.S., Ph.D., Oceanic Fine Structure, Nearshore Environmental Problems
Grigg, R.W., Ph.D., Ecology of Hermatipic and Ahermatipic Corals

Groves, G.W., Ph.D., Theory of Waves and Tides
Hirota, J., Ph.D., Zooplankton Distribution, Trophic Dynamics, and Natural History
Hurd, D.C., Ph.D., Marine Biogeochemistry of Silica
Karl, D.M., Ph.D., Marine Microbial Ecology
Kroopnick, P.M., Ph.D., Isotope Geochemistry, Geothermal Resources, Paleoenvironments
Law, E.A., Ph.D., Phytoplankton Ecology
Magaard, L., Ph.D., Oceanic Waves and Turbulence
Margolis, S.V., Ph.D., Chairman of Oceanography, Sediment Geochemistry and Paleoceanography, SEM and Microprobe Analysis
Smith, S.V., Ph.D., Nearshore Ecosystem Biogeochemistry, Environmental Response Characteristics
Stroup, E.D., Ph.D., Descriptive Physical Oceanography, Equatorial Circulation, Atoll Circulation
Woodcock, A.H., Ph.D., Sea-produced Atmospheric Particles, Air-Sea Interaction, Hawaiian Alpine Lake Studies
Wyrtki, K., Ph.D., Oceanic Circulation, Large-scale Ocean-Atmosphere Interaction
Young, R.E., Ph.D., Deepsea Cephalopod Ecology, Function of Bioluminescence in the Deepsea

Affiliate Faculty

Spielvogel, L.Q., Ph.D., Mathematical Physics of Ocean

ZOOLOGY

Intended candidates for the M.S. or Ph.D. degrees in Zoology must present a minimum of 18 hours of undergraduate preparation in zoology, including courses in vertebrate zoology (including comparative anatomy), embryology, and physiology, and have completed two years of chemistry (inorganic and organic), one year of physics and courses in calculus and botany.

Zoology courses listed below receive graduate credit if not taken to satisfy undergraduate deficiencies. One seminar or topics course each year is required. 702 and 800 are required only for Ph.D. candidates. For the M.S. under Plan A a maximum of six hours, and under Plan B a minimum of six hours, may be elected from related courses in botany, chemistry, entomology, genetics, mathematics, meteorology, oceanography, physics, psychology and other related areas. For the Ph.D., additional work will be stipulated by the supervising committees. Ph.D. candidates must pass a reading examination in one foreign language.

The following courses are offered in conjunction with the above programs:

PHYSIOLOGY

701	Hyperbaric and Diving Physiology	3

ZOOLOGY

411	Zoology of the Lower Invertebrates	4
412	Zoology of the Higher Invertebrates	4
416	Histology	3
417	Microtechnique	3
420	Embryology	4
421	Developmental Biology	3
430	Animal Physiology	4
435	Endocrinology	2
439	Animal Ecology	3
440	Laboratory in Animal Ecology	1
441	History of Zoology	2
450	Natural History of the Hawaiian Islands	2
460	Avian Biology	3
465	General Ichthyology	3
470	Limnology	3
480	Animal Evolution	3
485	Biogeography	3
497	Comparative Physiology	3
498	Comparative Physiology Lab	2
604	Comparative Endocrinology	3
605	Comparative Endocrinology Laboratory	1
606	Principles of Animal Behavior	2
607	Principles of Animal Behavior Laboratory	1
608	Growth and Form	4
609	Biology of Symbiosis	3
610	Topics in Developmental Biology	Variable
619	Seminar in Teaching	1
620	Marine Ecology	3
622	Isotopic Tracers in Biology	3
631	Biometry	3
632	Advanced Biometry	3
642	Cellular Neurophysiology	3
666	Advanced Ichthyology	3
691	Seminar in Zoology	1
699	Directed Research	Variable
702	Preparation of Scientific Manuscripts	1
714	Topics in Animal Behavior	Variable
715	Topics in Invertebrate Zoology	3
716	Topics in Fish and Fisheries Biology	3
718	Topics in Animal Physiology	3
800	Thesis Research	Variable

The instructional staff for the courses listed above consists of the following:

Ahearn, G.A., Ph.D., Invertebrate and Environmental Physiology
Arnold, J.M., Ph.D., Developmental Biology
Bailey-Brock, J.H., Ph.D., Invertebrate Zoology
Banner, A.H., Ph.D., Invertebrate Zoology, Systematics
Bardach, J.E., Ph.D., Sensory Physiology, Behavior, Ecology
Berger, A.J., Ph.D., Ornithology, Human and Avian Anatomy
Cooke, I.M., Ph.D., Cellular Neurophysiology, Neurosecretion
Hadfield, M.G., Ph.D., Developmental Biology of Invertebrates
Haley, S.R., Ph.D., Invertebrate Embryology
Helfrich, P., Ph.D., Ichthyology, Ecology
Kamemoto, F.I., Ph.D., Chairman of Zoology, Comparative Endocrinology
Kane, R.E., Ph.D., Cell Biology
Kay, E.A., Ph.D., Malacology
Kinzie, R.A., III, Ph.D., Coral Reef Biology, Marine Ecology
Losey, G.S., Jr., Ph.D., Marine Ecology, Behavior
Maciolek, J.A., Ph.D., Limnology, Fishery Biology
May, R.C., Ph.D., Aquaculture, Fish Development
Popper, A.N., Ph.D., Sensory Processes of Animal Communication
Reed, S.A., Ph.D., Coral Physiology
Reese, E.S., Ph.D., Behavior, Ecology, Invertebrate Zoology
Stevens, E.D., Ph.D., Physiology
Stimson, J.S., Ph.D., Population Ecology, Marine Ecology
Tester, A.L., Ph.D., Fishery Biology, Biometry
Townsley, S.J., Ph.D., Invertebrate Zoology, Ecology, Radiobiology

van Weel, P.B., Ph.D., Physiology, Physiological Ecology

Affiliate Faculty

Evans, E.C., III, Ph.D., Cetacean Sonar Systems
Harvey, G.W., Ph.D., Cetacean Sound Production and Reception, Air-Sea Interface Analysis
Hester, F.J., Ph.D., Fishery Biology
Kendall, J.I., Ph.D., Histology
Randall, J.E., Ph.D., Ichthyology
Takata, M., M.S., Fishery Biology
Taylor, L.R., Ph.D., Ichthyology
Ziegler, A.C., Ph.D., Vertebrate Zoology

To obtain further information, address inquiries to:

John P. Craven, Dean
Marine Programs
Holmes Hall, Room 401
2540 Dole Street
Honolulu, Hawaii 96822

UNIVERSITY OF HOUSTON
Houston, Texas 77004

Graduate students interested in marine biology may participate in a program jointly administered by the University of Houston (UH) and the National Marine Fisheries Service (NMFS). Students take advanced courses at the UH Central Campus in Houston and conduct research in laboratories at the NMFS facility in Galveston, 45 miles south of Houston. A wide range of research expertise encompassing both applied and basic areas is available to participants.

Marine Science Program Facilities at Galveston

Graduate students have access to laboratories of UH and NMFS, as well as an estuarine area of 180 acres with wet laboratory managed by NMFS. The main laboratory facilities have a circulating seawater system, several wet laboratories, algal culture rooms, aqua culture raceways, and a hatchery. Research equipment available to UH students includes a transmission electron microscope, polarized and fluorescence microscopes, ultra and refrigerated centrifuges, recording spectrophotometers, densitometer, scintillation counter, gas chromatography, incubators, ultracold freezer, Coulter Counter, electrophoresis equipment, remote computer terminal, also a field vehicle and a 14-foot boat with a variety of sampling gear.

The following degrees are offered:

1. M.S. in Biology specializing in Marine Biology. (Six M.S. degrees granted this year.)

a) Thirty credits including six hours thesis and six hours minor.
b) Candidacy Examination.
c) Presentation and defense of a Master's thesis.

2. Ph.D. in Biology specializing in Marine Biology. (One Ph.D. granted this year.)

a) No specific course hour requirement except as specified by committee; six hours in approved minor required.
b) Qualifying Examination by 20th month.
c) Presentation and defense of Ph.D. dissertation.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Bio	2317	Environmental Biology	3
Bio	3344	Pollution Biology	3
Bio	4197	Selected Topics in Biology	Arranged
Bio	4198	Special Problems	Arranged
Bio	4267	Ecological Methods	2
Bio	4340	Marine Microbiology	3
Bio	4367	Ecology	3
Bio	4440	Invertebrate Zoology	4
Bio	4442	Marine Biology	4
Geol	1377	Introductory Oceanography	3
Geol	4379	Physical Oceanography	3
Geol	4382	General Oceanography	3

GRADUATE COURSES

Bio	6198	Special Problems	Arranged
Bio	6413	Microbial Ecology	4
Bio	6435	Marine Plants	4
Bio	7195	Selected Topics in Marine Biology	Arranged
Bio	7382	Marine Science Seminar	3
Geol	6330	Marine Geology	3
Geol	6331	Marine Geophysics	3

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Baust, John G., Ph.D., Associate Professor
Caillouet, Charles W., Ph.D., Adjunct Professor
Howe, Nathan R., Ph.D., Assistant Professor
Klima, Edward F., Ph.D., Adjunct Professor
Leong, Jorge K., Ph.D., Adjunct Professor
Lester, L. James, Ph.D., Assistant Professor
Loeblich, Alfred R., III, Ph.D., Associate Professor
Loeblich, Laurel A., Ph.D., Research Associate
McVey, James, Ph.D., Adjunct Professor
Sizemore, Ronald K., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Graduate Chairman
Department of Biology
University of Houston
4800 Calhoun
Houston, Texas 77004

UNIVERSITY OF MAINE
Orono, Maine 04469

The University of Maine offers marine-related courses both at the Orono campus and the university marine station, the Ira C. Darling Center. The Orono campus provides classrooms, laboratories and courses which integrate field work with study. Although no undergraduate degree programs in marine science exist, the Center for Marine Studies at Orono suggests certain elective courses to enhance major curricula by providing an introduction to marine studies.

At the Darling Center, 100 miles south of Orono on the coast, facilities on a 136-acre site include classrooms and research laboratories, access terminal for the Orono computing equipment, library, year-round accommodations for students, two 34-foot research vessels and small craft, a deepwater pier and waterfront facilities. Open ocean research capability is provided by the UNOLS fleet and cooperative use of vessels at other institutions.

The Department of Oceanography, primarily located at the Darling Center, offers a program of study and research leading to the M.S. and Ph.D. Specific fields of research include planktology, benthic and polar ecology, aquaculture, marine fishes, phycology, pollution, micropaleontology, paleomagnetics, tectonics, petrology and chemistry.

Ph.D. in Oceanography. Required courses are Biological, Chemical, Physical Oceanography and Marine Geology; courses IDL 201, OC 220, 241, and 260 respectively. Students must register for the Seminar in Oceanography (OC 391) which requires presentation of one seminar each year. All degree candidates are required to participate in regular oceanic cruise, demonstrate reading knowledge of two foreign languages and complete and defend a research dissertation.

The following are marine-related courses offered in conjunction with the above programs; both graduate and undergraduate. To avoid duplicate listings, those that are offered in two or more departments are cataloged as IDL courses. All 200 level courses are graduate courses, open to undergraduates with the necessary prerequisites.

UNDERGRADUATE AND GRADUATE COURSES

ANTHROPOLOGY

AY 122	Folklore-Maine and the Maritime Provinces	3

ASTRONOMY

AS 14	Celestial Navigation	3

BOTANY

BT 173	Marine Phycology	4
BT 203	Ecology and Natural History of Marine Algae (tentative)	4

ECONOMICS

EC 160	Bioeconomics (tentative)	3
EC 173	Price Theory - Fisheries	3
EC 260	Seminar in Common Property Economics	3

EDUCATION

EDC 146	Natural Science Education - Coastal (elementary)	3
EDC 147	Natural Science Education - Coastal (secondary)	3
EDX 162	Workshop in Marine Education (summer)	

GEOLOGY

GY 1,2	Aspects of the Natural Environment	4
GY 114	Invertebrate Paleontology	3
GY 221	Low Pressure-Temperature Geochemistry	2
GY 232	Sedimentology	3
GY 241	Glacial Geology	3

(see IDL courses also)

HISTORY

HY 185,6	Man and the Sea	3

INTERDISCIPLINARY LISTING

IDL 11	(OC, ZO)	Aquaculture	3
IDL 119	(BT, GY, ZO)	Ecology	3
IDL 170	(OC, ZO)	Introduction to Oceanography	3
IDL 201	(OC, ZO)	Biological Oceanography	3
IDL 208	(OC, ZO)	Anatomy and Classification of Fishes	5
IDL 210	(OC, ZO)	Marine Invertebrate Zoology (summer-D. Center)	5
IDL 211	(OC, ZO)	Larval Biology of Marine Invertebrates	5
IDL 260	(GY, ZO)	Marine Geology	3
IDL 263	(BT, OC, ZO)	Marine Benthic Ecology	3
IDL 264	(GY, OC)	Structure and Tectonics of the Sea Floor	3
IDL 266	(GY, OC)	Micropaleontology	4
IDL 267	(GY, OC)	Actuopaleontology	2
IDL 268	(GY, OC)	Deep Sea Stratigraphy and Paleoceanography	3
IDL 275	(GY, OC)	Late Quaternary Marine Paleoclimatology and Paleoceanography	3

MICROBIOLOGY

MB 210	Marine Bacteriology	3

OCEANOGRAPHY

OC 215	Taxonomy and Morphology of Crustacea	4
OC 216	Marine Phytoplankton	3
OC 218	Marine Zooplankton	3
OC 220	Chemical Oceanography	3
OC 241	Physical Oceanography	3
OC 391	Oceanographic Seminar	1
OC 393	Problems in Biological Oceanography	Arranged
OC 399	Graduate Thesis	Arranged

ZOOLOGY

ZO 101	Natural History of the Maine Coast (summer)	
ZO 131	Vertebrate Biology	4
ZO 153	Invertebrate Zoology	4
ZO 171	Fishery Biology	3
ZO 210	Marine Invertebrate Zoology (summer-Darling Center)	5
ZO 212	Marine Polar Ecology	3
ZO 220	Population Biology	3
ZO 222	Community Ecology	3
ZO 231	Fish Physiology	5
ZO 273	Fisheries Science	2
ZO 292	Functional Anatomy of Marine Invertebrates	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY

Vadas, Robert L., Ph.D., Professor of Botany, Oceanography and Zoology

DEPARTMENT OF GEOLOGICAL SCIENCES

Borns, Harold W., Jr., Professor of Geological Sciences and Director of the Quaternary Institute

Denton, George H., Ph.D., Professor of Geological Sciences and Quaternary Studies

Hall, Bradford A., Ph.D., Chairperson and Professor of Geological Sciences

Norton, Stephen A., Ph.D., Professor of Geological Sciences and Cooperative Assistant Professor of Oceanography

Osberg, Philip H., Ph.D., Professor of Geological Sciences

DEPARTMENT OF MICROBIOLOGY

Pratt, Darrell B., Ph.D., Chairperson and Professor of the Department and Professor of Zoology

DEPARTMENT OF OCEANOGRAPHY

Dean, David, Ph.D., Professor of Oceanography and Zoology

DeWitt, Hugh H., Ph.D., Chairperson and Associate Professor of Oceanography, Cooperative Assistant Professor of Zoology

Fink, L. Kenneth, Jr., Associate Professor of Oceanography and Cooperative Assistant Professor of Geological Sciences

Hidu, Herbert, Ph.D., Associate Professor of Oceanography and Cooperative Assistant Professor of Zoology

Mayer, Lawrence, Assistant Professor of Oceanography and Cooperative Assistant Professor of Chemistry and Geological Sciences

McAlice, Bernard J., Ph.D., Associate Professor of Oceanography and Cooperative Assistant Professor of Zoology

Revelante, Noelia, Ph.D., Associate Research Professor of Oceanography

Schnitker, Detmar F., Ph.D., Associate Professor of Oceanography and Quaternary Studies, Cooperative Assistant Professor of Zoology

Watling, Leslie E., Ph.D., Assistant Professor of Oceanography and Cooperative Assistant Professor of Zoology

DEPARTMENT OF ZOOLOGY

Dearborn, John H., Ph.D., Professor of Oceanography and Zoology

Gilmartin, Malvern, Ph.D., Director of the Center for Marine Studies and Professor of Zoology

McCleave, James D., Ph.D., Professor of Zoology

Shick, J. Malcolm, Ph.D., Assistant Professor of Zoology

Sidell, Bruce D., Ph.D., Assistant Professor of Zoology

To obtain further information, address inquiries to:

Center for Marine Studies
Coburn Hall
University of Maine at Orono
Orono, Maine 04469

UNIVERSITY OF MARYLAND
College Park, Maryland 20742

THE MARINE-ESTUARINE-ENVIRONMENTAL SCIENCE PROGRAM

Students seeking a degree in Marine-Estuarine-Environmental Science, the principal program for marine science, or in marine concentrations in other programs have access to the extensive research facilities of the University's Center for Environmental and Estuarine Studies. The Center has complete laboratory facilities for research in marine sciences located on the Chesapeake Bay at the Horn Point Environmental Laboratory near Cambridge, Maryland, and at the Chesapeake Biological Laboratory at Solomons, Maryland. In addition to a Shellfish Aqaculture Research Laboratory and a Controlled Environment Laboratory at these facilities, students also have access to a fleet of laboratory-equipped research vessels and smaller craft, which are available for work on the Chesapeake Bay or other waters.

In addition, students will find their work greatly enhanced by the special ties most faculty maintain to the many government laboratories and agencies in the Washington-Baltimore area. Library resources, which include the Library of Congress and the National Agricultural Library, are among the best in the nation. The University also has an active Sea Grant research program, with its main office located on the College Park Campus.

A new University-wide program in Marine-Estuarine-Environmental Sciences (MEES) has been developed, which offers work leading to the M.S. (thesis option option only) and Ph.D. degrees. Degree work may be pursued on a part-time basis. The program is interdisciplinary, and areas of specialization include marine and estuarine ecology, environmental biology, environmental chemistry, environmental microbiology, environmental toxicology, environmental management, marine and environmental technology, and fisheries and wildlife management.

Applicants are judged on the basis of their previous academic work and scores on the GRE Aptitude Test. Each student will work closely with an advisory committee, and the course of study will be tailored to the individual student's needs and goals.

The program includes a core curriculum of courses selected from three (for the M.S.), or four (for the Ph.D.), of the following areas: ecology and/or physiology of plants or animals; biochemistry; ecology and/or physiology of microorganisms; physical, chemical, engineering, or geological sciences; and management (economics, resource development, systems analysis, or biology and management of various natural resources). Statistics is required of all degree candidates. Any prerequisites for courses may be met through coursework after the student is admitted to the graduate program.

Some of the courses available for students in MEES and other programs are listed below:

AREC 453	Economic Analysis of Natural Resources	3
AREC 639	Internship in Resource Management	3
AGEN 422	Soil and Water Engineering	3
AGEN 433	Engineering Hydrology	3
AGEN 605	Land and Water Resource Development Engineering	3
ANSC 411	Biology and Management of Shellfish	4
ANSC 414	Biology and Management of Fish	4
ANSC 480	Special Topics in Fish and Wildlife Management	3
BOTN 471	Marine and Estuarine Botany	3
BOTN 672	Physiology of Algae	2
CHEM 474	Environmental Chemistry	3
CHEM 476	Geochemistry of the Biosphere	3
CHEM 723	Marine Geochemistry	3
ENCE 431	Surface Water Hydrology	3
ENCE 433	Environmental Health Engineering Analysis	3
ENCE 633	The Chemistry of Natural Waters	4
GEOL 452	Marine Geology	3
GEOL 475	General Oceanography	3
ENME 450	Mechanical Engineering Analysis for the Oceanic Environment	3
ENME 653	Topics in Hydrodynamics	3
METO 420	Physical and Dynamical Oceanography	3
METO 422	Oceanic Waves, Tides, and Turbulence	3
MICR 430	Marine Microbiology	2
MICR 470	Microbial Physiology	4
ZOOL 473	Marine Ecology	3
ZOOL 481	Biology of Marine and Estuarine Invertebrates	4
ZOOL 482	Marine Vertebrate Zoology	4
ZOOL 673	Advanced Aquatic Ecology	4
ZOOL 677	Ecology of Marine Communities	4
ZOOL 682	Ecology of Marine Invertebrates	4
MEES 799	Thesis Research	1-6
MEES 899	Doctoral Dissertation Research	1-6

The faculty program committee for MEES is listed below:

Bonar, Dale, Ph.D., Assistant Professor of Zoology
Colwell, Rita R., Ph.D., Professor of Microbiology
Cooney, Joseph, Ph.D., Research Professor, Chesapeake Biological Laboratory
Helz, George, Ph.D., Associate Professor of Chemistry
Hetrick, Frank, Ph.D., Professor of Microbiology
Menzer, Robert E., Ph.D., Professor of Entomology
Norton, Virgil, Ph.D., Professor of Agricultural and Resource Economics
Pitter, Richard, Ph.D., Assistant Professor of Meteorology
Sulkin, Stephen, Ph.D., Research Associate Professor, Horn Point Environmental Laboratory
Van Valkenburg, Shirley, Ph.D., Assistant Professor of Botany

To obtain further information, address inquiries to:

Dr. Robert E. Menzer
Graduate School
South Administration Building
Univeristy of Maryland, College Park
College Park, Maryland 20742

DEPARTMENT OF BOTANY

The Department of Botany offers M.S. and Ph.D. degrees with a specialty in marine botany. A full complement of courses, including "Marine Plant Botany" and "Special Problems in Marine Research", is available for interested students. Students are urged to expand their training by summer study at the Marine Biological Laboratory at Woods Hole, Massachusetts.

To obtain further information on the program, address all inquiries to:

Professor Edward P. Karlander
Department of Botany
University of Maryland
College Park, Maryland 20742

DEPARTMENT OF MICROBIOLOGY

The Department of Microbiology, which offers the M.S. and Ph.D. degrees, also has a specialty in marine microbiology. Extensive research programs focus primarily on biochemical ecology, with emphasis on the following areas: fish and shellfish diseases; the survival and distribution of human pathogens through marine environments; deep ocean research; the role of bacteria in the breakdown of toxic chemical pollutants, in the degradation, and in the nutrient cycling of marine life. Dr. Joseph Cooney, head of the Chesapeake Biological Laboratory, is also a member of the microbiology faculty, and students often engage in special research projects at that facility.

To obtain further information on the program, address all inquiries to:

Professor Rita R. Colwell
Department of Microbiology
University of Maryland
College Park, Maryland 20742

DEPARTMENT OF ZOOLOGY

The Department of Zoology offers the M.S. and Ph.D. degrees with specialization in estuarine and marine biology. Research interests of the seven faculty members who instruct in this area include: the distributional ecology of stream benthic invertebrates; the morphology and behavior of elasmobranch fishes and marine teleost fishes of the Red Sea and western tropical and north Atlantic; the environmental physiology of marine invertebrates; the biology of estuarine and marine protozoa; biogeography; intertidal ecology; the developmental biology of marine invertebrates; and the reproductive strategies and evolutionary dynamics of marine host-parasite systems. Students have access to research facilities of the Center for Environmental and Estuarine Studies on the Chesapeake Bay, but they are encouraged to spend at least one summer at a marine biological laboratory outside the Bay area for broader experience with marine environments.

To obtain further information on the program, address all inquiries to:

Professor Sidney K. Pierce
Department of Zoology
University of Maryland
College Park, Maryland 20742

Other programs at the University of Maryland, College Park which offer coursework in various areas of marine science include Agricultural and Resource Economics, Agricultural (and aquacultural) Engineering; Civil Engineering; and Mechanical Engineering. For information on these programs and courses, students should consult a copy of the *UMCP Graduate Catalog* or write for information to the Graduate School, South Administration Building, University of Maryland, College Park, Maryland 20742.

THE UNIVERSITY OF MASSACHUSETTS
Amherst, Massachusetts 01003

The Marine Station, an interdisciplinary research facility operated by the Graduate School, is located on the North Shore of Cape Ann, midway between Gloucester and Rockport. Deep water mooring is provided for research vessels. The Station is equipped for a wide range of marine studies, and contains cultural facilities, darkrooms, instrument rooms, a seawater system, a machine shop, a small library, a large general purpose laboratory and the Coordinator's office. Both basic and applied research is conducted by faculty and graduate students from the Amherst campus with research accommodations made, on a priority basis, for visiting scientists, faculty and students from other institutions.

The Marine Station, described above, is the site of much interdisciplinary research and study, although the Marine Science Program at the University is not admitting students at this time.

The Departments of Botany, Civil Engineering, Food Science and Nutrition, Geology/Geography, Wildlife and Fisheries Biology, and Zoology all offer courses related to Marine Science.

The instructional staff consists of the following:

Carritt, Dayton E., Ph.D., Professor of Geology
Cole, Charles F., Ph.D., Professor of Fisheries Biology
Edwards, D. Craig, Ph.D., Professor of Zoology
Godfrey, Paul J., Ph.D., Associate Professor of Botany
Harris, Denton B., Ph.D., Assistant Professor of Civil Engineering
Hultin, Herbert O., Ph.D., Professor of Food Science and Nutrition
Nash, William A., Ph.D., Professor of Civil Engineering
Webb, Gregory W., Ph.D., Professor of Geology
Wilce, Robert T., Ph.D., Professor of Botany

To obtain further information, address inquiries to:

Dean of the Graduate School
University of Massachusetts
Amherst, Massachusetts 01003

UNIVERSITY OF MIAMI
ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE
Miami, Florida 33149

The geographical location of the Rosenstiel School of Marine and Atmospheric Science is unique in many important aspects. The Gulf Stream brings to Miami an essentially tropical environment and offers itself as an ideal object for mass transport studies. Coral reefs grow vigorously off the Florida Keys, providing a living laboratory for the study of numerous species and ecological relationships. The Everglades-Florida Bay ecological system provides a natural laboratory for the study of marine organisms important to fishery science.

The School's seven-acre campus is located on Virginia Key, which is a few miles from downtown Miami and the University of Miami's Coral Gables campus. Virginia Key is connected to the mainland.

The Gilbert Hovey Grosvenor, Agassiz, and Collier buildings house classrooms and research laboratories, which are well equipped for the many needs of modern oceanographic research. These include radiation dection, tritium measurements, mass spectrometry, x-ray diffraction, optical spectroscopy, atomic absorption, electron microscopy, and carbon-14, potassium-argon, and uranium-thorium dating. The Grosvenor building also houses the catalogued biological research collections which include 27,000 lots and 2,500 species of fishes, and 11,500 lots and 3,700 species of marine invertebrates.

The Alfred C. Glassell, Jr. Laboratory has circulating seawater aquaria throughout and is used for biological research on marine animals, ranging from plankton to sharks. Within its walls, it is possible to reproduce and maintain natural or artificial environments, controllable in such parameters as temperature, salinity, turbidity and pH.

The Henry L. Doherty Marine Science Center, opened in mid-1971, has an auditorium, a computer center, conference rooms, a large dining room, a geological-biological reference center, and houses a library with its 25,000 volumes (books and periodicals) and 22,000 reprints.

The School's Division of Atmospheric Science is housed in the Computer Center at the University's Coral Gables campus, in close proximity to the Radar Meteorological Laboratory. In addition, the facilities of the various schools and departments within the University are available to researchers and students in the School.

Comparative sedimentology, fisheries, and pollution research are carried out at the 14.9-acre Fisher Island Station in Biscayne Bay and the experimental nursery for pink shrimp and pompano is located at Turkey Point, about 30 miles south of Virginia Key.

For research and training in ecology, the University operates two field stations. One is at Pigeon Key, 100 miles south of Miami in the Florida Keys, and the other is in Everglades National Park, about 40 miles from the Coral Gables campus.

The School maintains a fleet of oceanographic research vessels. The largest of the fleet, the 208-foot R/V James M. Gilliss, was assigned in 1971 to the University by the Oceanographer of the Navy. The Gilliss, designed and completely outfitted for deep-sea oceanographic research, has accommodations for 19 scientists and 22 crewmen.

R/V Columbus Iselin was launched in June 1972. An overall 170 feet in length, she has accommodations for 13 scientists and 12 crewmen. The size and range of the Iselin provides an excellent opportunity for "team" oceanographic studies in conjunction with Gilliss in the Straits of Florida, Gulf of Mexico, Caribbean Sea, equatorial Atlantic Ocean and the Pacific Ocean.

R/V Calanus is the School's major shallow-water research vessel. Measuring 62 feet in length, she possesses a maximum draft of approximately five feet. The vessel, with accommodations for five or six research personnel, was commissioned in the fall of 1970. Her research expeditions encompass offshore Miami waters and the Bahamas region.

The 45-foot R/V Orca III, constructed in 1972, provides a work platform for programs in local Biscayne Bay, Card Sound, Gulf Stream, and nearby reef areas. Although the vessel can accommodate up to 12 scientists on day trips, provisions are not made for overnight cruises due to her limited cruising range.

The following degrees are offered:

1. M.S. degree in Marine Science, with a major in atmospheric science, chemical oceanography, fisheries and applied estuarine ecology, marine biological oceanography, marine geology and geophysics, or physical oceanography. All students are required to complete 30 credits and a thesis representing original research or critical review of literature on a topic approved by the thesis committee. In most cases, an examination demonstrating a reading knowledge of a foreign language (French, German or Russian) and a comprehensive examination covering a general understanding of the major field as well as courses taken is required.

2. Ph.D. degree in Marine Science, with a major in atmospheric science, chemical oceanography, fisheries and applied estuarine ecology, marine biological oceanography, marine geology and geophysics, or physical oceanography. All students are required to obtain permission from their advisory committee and petition the academic faculty of the school to enter the Ph.D. program. The student must spend at least two consecutive semesters beyond the first year's graduate work in full-time study at the School. At least 36 graduate credits in courses and seminars are required (they may include courses taken for the M.S. degree, excluding thesis research credits), plus 24 credits of dissertation research. Up to 12 credits may be transferred from other institutions, if approved. In most cases a reading knowledge of two languages and a qualifying examination is required.

3. M.A. Program in Marine Studies, is an interdisciplinary program designed for those who wish to acquire a broad advanced training in the marine sciences in connection with their current or projected employment goals, for example, teachers, employees of government agencies, lawyers, or other professionals. It is not intended that this program should lead to a Ph.D. study involving basic research in a specialized branch of marine sciences, but that it should be an end in itself. It is expected that the total time to complete the requirements for the Master of Arts degree will be a minimum of one full year of full-time study. Twenty-four course credits are the minimum requirement for the M.A. degree. In addition, the student must enroll in a six-credit course in which he/she will research and produce a written report on a relevant topic.

4. Certificate Program in Fisheries and Applied Estuarine Ecology. A certificate program is available at the graduate level to provide professional training in various branches of fisheries for foreign students who may not have the academic background or sufficient proficiency in English to undertake advanced degree programs. Students in this program take regular graduate courses and can engage in research projects. They do not need to meet the academic standards required of students who are candidates for advanced degrees, but must achieve at least a C average. Ordinarily the minimum number of credits for completion of the certificate program is 14, but the number of credits and the actual courses chosen will depend on the particular needs of the individual student. A certificate will be given to those who complete the requirements at a satisfactory level of performance. Certificate students who perform well in graduate courses and who wish to do so can be admitted to regular advanced degree programs at the discretion of the faculty. Graduate course credits earned with satisfactory grades under the ceriticate program will count toward the degree program if students are admitted to the latter.

The following courses are offered in conjunction with the above programs:

BIOLOGY AND LIVING RESOURCES

BLR 503	Oceanography III	2
BLR 504	History of Biological Oceanography	2
BLR 509	Introduction to Fishery Science	3
BLR 510	Major World Fisheries	2

BLR 521	Marine and Fresh Water Algae	4
BLR 586	Fishes and Their Environment	3
BLR 601	Fishery Seminar	1
BLR 603	Fish Stocks and Their Management	4
BLR 604	General Biological Oceanography	3
BLR 606	Ecology of Marine Parasites	4
BLR 607	Non-Parasitic Diseases of Marine Organisms	3
BLR 608	Economics of Natural Resources	3
BLR 609	Mariculture	3
BLR 611	Structure and Function of Marine Ecological Systems	4
BLR 612	Biometrics in Marine Sciences	4
BLR 614	The Caribbean Marine Environment	3
BLR 621	Taxonomy of Marine Invertebrates	4
BLR 623	Invertebrate Embryology	2
BLR 624	Invertebrate Embryology Laboratory	2
BLR 625	Behavior of Marine Organisms	4
BLR 626	Advanced Studies in Ethology	2
BLR 627	Biology of Marine Mammals	4
BLR 630	Marine Microbiology	4
BLR 631	Plankton	4
BLR 632	Microplankton	4
BLR 633	Marine Biochemistry	2
BLR 634	Marine Biochemistry Seminar	1
BLR 636	Physiology of Marine Organisms	4
BLR 687	Systematics of Fishes	4
BLR 688	Biology of the Cephalopods	3
BLR 689	Marine Zoogeography	2
BLR 671-679	Advanced Studies	1-4

MARINE AND ATMOSPHERIC CHEMISTRY

MAC 502	Oceanography II	2
MAC 503	Principles of Chemical Oceanography	3
MAC 504	Chemical Oceanography Laboratory	1
MAC 581-582	Supervised Projects	1-4
MAC 603	Advanced Chemical Oceanography	3
MAC 610	Analytical Chemistry in Oceanography	3
MAC 620	Physical Chemical Oceanography	3
MAC 630	Organic Chemical Oceanography	3
MAC 660	Atmospheric Chemistry	3
MAC 670	Chemical Oceanography Seminar	1
MAC 680-685	Advanced Studies	1-4

MARINE GEOLOGY AND GEOPHYSICS

MGG 504	Oceanography IV	2
MGG 541	Field Evaluation of Fossil Platforms, Margins, and Basins	2
MGG 551	Marine Geology	3
MGG 552	Marine Geology Laboratory	1
MGG 581	Analytical Methods in Geochemistry	2
MGG 583	Scanning Electron Microscopy	2
MGG 584-589	Special Studies	1-4
MGG 605	Topics in Submarine Geology	2
MGG 611	Sedimentation	4
MGG 612	Principles of Micropaleontology	4
MGG 613	Geochemistry	4
MGG 614	Geophysics	4
MGG 615	Crystals and the Polarizing Microscope	4
MGG 661	Sedimentary Petrology	4
MGG 662	Comparative Sedimentology of Carbonates	4
MGG 664	Stratigraphic Micropaleontology	4
MGG 665	Paleoecology	3
MGG 666	Petrology of Deep Sea Rocks and Oceanic Islands	4
MGG 667	Sedimentary Geochemistry	4
MGG 668	Isotopic Processes in Earth Sciences	3
MGG 669	Advanced Geophysics	4
MGG 672	Facies Models and Basin Analysis	3
MGG 673	Environmental Geology	2
MGG 674	Geology of Florida	2
MGG 675	Cosmochemistry	3
MGG 676	Paleoclimatology	3
MGG 677	Submarine Volcanism and Its Products	3
MGG 678	Modeling of Marine Biogeochemical Processes	3
MGG 679	Marine Magnetism	2
MGG 681-689	Advanced Studies	1-4

METEOROLOGY AND PHYSICAL OCEANOGRAPHY

MPO 201	Introduction to Oceanography	3
MPO 202	Ocean and Laboratory Studies in Oceanography	1
MPO 501	Oceanography I	2
MPO 506	Physical Oceanography Laboratory	1
MPO 511	Geophysical Fluid Dynamics I	3
MPO 518	Remote Sensing of the Atmosphere	3
MPO 521	Estuarine and Coastal Processes	3
MPO 531	Physical Meteorology	3
MPO 532	Radar Meteorology	3
MPO 541	Optical Meteorology	3
MPO 542	Satellite Oceanography	3
MPO 551	Introduction to Atmospheric Science	3
MPO 552	Synoptic Meteorology Laboratory	1
MPO 575	Applied Ocean Hydrodynamics	3
MPO 581-582	Supervised Projects	1-4
MPO 601-610	Seminars in Meteorology and Physical Oceanography	1
MPO 611	Geophysical Fluid Dynamics II	3
MPO 612	Large Scale Ocean Circulation	3
MPO 621	Waves and Tides I	3
MPO 623	Statistical Analysis of Geophysical Data	3
MPO 625	Waves and Tides II	3
MPO 631	Air-Sea Interaction	3
MPO 632	Planetary Fluid Dynamics	3
MPO 641	Tropical Meteorology	3
MPO 660	Cloud Physics	3
MPO 661	Synoptic Scale Meteorology	3
MPO 662	Computer Models in Fluid Dynamics	3
MPO 663	Convective and Mesoscale Meteorology	3
MPO 664	Atmospheric Turbulence	3
MPO 665	General Circulation of the Atmosphere	3
MPO 671-675	Advanced Studies	1-4

The School also offers a joint program in ocean engineering with the School of Engineering and Environmental Design. This program enables engineering graduates to pursue study in ocean engineering and ocean related sciences. The M.S. degree is offered either with a major in ocean engineering or with a major in one of the traditional fields of engineering with a minor in ocean engineering. The areas of specialization in ocean engineering are ocean measurements, underwater acoustics, marine corrosion, underwater structures or coastal engineering. In addition to the M.S. degree program, a qualified student may elect a minor in ocean engineering as part of the Ph.D. program in the Departments of Civil or Mechanical Engineering.

The following courses are offered in conjunction with the above program:

OCEAN ENGINEERING

OEN 502	Introduction to Ocean Engineering	1
OEN 531	Oceanographic Measurements	3
OEN 535	Introduction to Underwater Acoustic	3
OEN 551	Special Problems	1-3

OEN 636	Applied Underwater Acoustics I	3
OEN 654	Random Signals and Noise	3
OEN 671	Underwater Acoustics Laboratory	1
OEN 672	Advanced Underwater Acoustics	3
OEN 673	Applied Underwater Acoustics II	3
OEN 675	Applied Ocean Hydrodynamics	2
OEN 677	Engineering of Ocean Systems	2
OEN 681	Materials in the Marine Environment	2
OEN 682	Marine Corrosion Laboratory	1
OEN 683	Advanced Marine Corrosion	2
OEN 686	Advanced Ocean Measurements	2
OEN 689	Ocean Engineering Seminar	1
OEN 693	Special Topics	1-3
OEN 698	Advanced Topics in Ocean Engineering	1-3

Professional study of the law of the marine environment is offered at two degree levels in the School of Law in an interdisciplinary program with the School of Marine and Atmospheric Science. The area of concentration program offers a specialization in Ocean Law during the three-year period of study for the basic J.D. law degree. For lawyers with a J.D. degree, the LL.M. degree is offered in ocean law to qualify the attorney as an advanced specialist in the legal problems of the ocean environment in preparation for a career in practice, industry or government.

The following courses are offered in conjunction with the above program:

SCHOOL OF LAW

LAW 806	Admiralty	3
LAW 810	The Ocean and Its Resources	2
LAW 819	Ocean Law	2-3
LAW 823	Coastal Law	3
LAW 866	International Law	3
LAW 869	Marine Pollution Law	3
LAW 985	Ocean Law Seminar	2

SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

BLR 608	Economics of Natural Resources	3
OEN 689	Ocean Engineering Seminar	2

The instructional and research staff for the Rosenstiel School of Marine and Atmospheric Science is as follows:

DIVISION OF BIOLOGY AND LIVING RESOURCES

Cooksey, Keith, Ph.D., Professor
Corcoran, Eugene, Ph.D., Professor
de Sylva, Donald, Ph.D., Professor
Fell, Jack, Ph.D., Professor
Gruber, Samuel, Ph.D., Associate Professor
Higman, James, M.S., Research Assistant Professor
Houde, Edward, Ph.D., Professor
Iversen, Edwin, Ph.D., Professor
Lutz, Peter, Ph.D., Associate Professor
Michel, Harding, Ph.D., Professor
Mitsui, Akira, Ph.D., Professor
Myrberg, Arthur, Ph.D., Professor
Odell, Daniel, Ph.D., Assistant Professor
Reeve, Michael, Ph.D., Professor
Richard, Joseph, B.S., Associate Professor
Robins, Richard C., Ph.D., Professor
Roman, Michael, Ph.D., Assistant Professor
Snedaker, Samuel, Ph.D., Associate Professor
Staiger, Jon, Ph.D., Research Associate Professor
Stevenson, Robert, Ph.D., Assistant Professor
Taylor, Barrie, Ph.D., Professor
Taylor, Dennis, Ph.D., Professor
Thomas, Lowell, Ph.D., Professor
Voss, Gilbert, Ph.D., Professor
Voss, Nancy, M.S., Research Associate Professor
Williams, Francis, D.Sc., Professor
Wisby, Warren, Ph.D., Professor

DIVISION OF MARINE AND ATMOSPHERIC CHEMISTRY

Carpenter, James, Ph.D., Professor
Corbett, Michael D., Ph.D., Associate Professor
Fine, Rana, Ph.D., Research Assistant Professor
Lo Surdo, Antonio, Ph.D., Research Assistant Professor
Mason, Allen, Ph.D., Research Associate Professor
Millero, Frank, Ph.D., Professor
Morse, John W., Ph.D., Associate Professor
Ostlund, Gote, Ph.D., Professor
Smith, Carroll, M.S., Research Associate Professor

DIVISION OF MARINE GEOLOGY AND GEOPHYSICS

Bock, Wayne, Ph.D., Associate Professor
Fisher, David, Ph.D., Professor
Ginsburg, Robert, Ph.D., Professor
Harrison, Christopher, Ph.D., Professor
Hay, William, Ph.D., Professor
Honnorez, Jose, Ph.D., Associate Professor
Joensuu, Oiva, Ph.D., Associate Professor
Marszalek, Donald, Ph.D., Assistant Professor
Moore, Donald, Ph.D., Associate Professor
Prospero, Joseph, Ph.D., Professor
Schlager, Wolfgang, Ph.D., Associate Professor
Southam, John, Ph.D., Associate Professor
Wanless, Harold, Ph.D., Assistant Professor

DIVISION OF METEOROLOGY AND PHYSICAL OCEANOGRAPHY

Bleck, Ranier, Ph.D., Associate Professor
Brown, Otis, Ph.D., Research Assistant Professor
Duing, Walter, Ph.D., Professor
Evans, Robert H., Ph.D., Research Assistant Professor
Estoque, Mariano A., Ph.D., Professor
Geisler, John E., Ph.D., Professor
Geller, Marvin, Ph.D., Professor
Gerrish, Harold, M.S., Assistant Professor
Gordon, Howard R., Ph.D., Professor
Kraus, Eric B., Dr. rer. nat., Professor and Director
Leaman, Kevin D., Ph.D., Assistant Professor
Lee, Thomas N., Ph.D., Research Associate Professor
Lhermitte, R.M., Ph.D., Professor
Merrill, John, Ph.D., Assistant Professor
Pitcher, Eric J., Ph.D., Assistant Professor
Rooth, Claes C.H., Ph.D., Professor
Schott, Friedrich, Ph.D., Associate Professor
Van Leer, John C., Ph.D., Associate Professor

DIVISION OF OCEAN ENGINEERING

DeFerrari, Harry, Ph.D., Professor
Kimball, Christopher, Ph.D., Research Associate Professor
Le Mehaute, Bernard, Ph.D., Professor
Tappert, Frederick, Ph.D., Professor
Tusting, Robert, M.S., Research Associate Professor

Van de Kreeke, Jacobus, Ph.D., Associate Professor
Wang, John, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. Warren J. Wisby
Associate Dean for Graduate Studies
School of Marine and Atmospheric Sciences
University of Miami
10 Rickenbacker Causeway
Miami, Florida 33149

THE UNIVERSITY OF MICHIGAN
Ann Arbor, Michigan 48109

Marine and related programs at The University of Michigan are spread across a number of departments and interdisciplinary programs. One focus of marine-related activity is the Great Lakes and Marine Waters Center (GLMWC) established in 1974 to coordinate Great Lakes research programs. The GLMWC operates the university research vessels and many of the faculty teaching in the marine curricula participate in GLMWC research activities.

At present, more than 150 scientists and staff carry on research in areas of impacts of thermoelectric power plants on aquatic systems, the fate and impact of toxic substances, the relationship of nutrients cycling and loading on productivity, eutrophication processes, the design of monitoring programs, coastal processes, and sedimentary environment.

The University of Michigan provides the Great Lakes and Marine Waters Center with approximately 25,000 square feet of laboratories and offices. This space is divided among the three component groups of GLMWC: the Great Lakes Research Division; the Michigan Sea Grant Program; and the Great Lakes Resource Management Program.

Included in the facilities are very well equipped laboratories of benthos, plankton, zooplankton, chemistry, fish and a scanning electron microscope facility. The usual laboratory equipment is available, and in addition we operate four autoanalyzers, an oscilloscope particle data counter, and neutron activation equipment. We have online computer equipment for laboratory and field use.

The Great Lakes and Marine Waters Center owns and operates a number of well-equipped research vessels, including: (1) the *R/V Laurentian*, 80-foot steel hull, (2) the *R/V Mysis*, 50-foot steel hull, (3) the *R/V Coastal Spirit*, 20-foot fiberglass hull, (4) the *R/V Outrage*, 21-foot fiberglass hull.

The University of Michigan has operated ships on the Great Lakes since 1957 and has an extensive record of lakes-related cooperative ventures with other institutions in the region. The *Laurentian* and the *Mysis*, are available as a regional resource to help meet the needs of academic scientists requiring capable mobile platforms for research on the Great Lakes.

The *Laurentian*, completed in 1974, is an 80-foot vessel with accommodations for a scientific party of 10 in single, double, and four-person rooms. This ship has two permanent laboratories (a 144-foot below decks lab) and can accommodate portable laboratories or large, self-contained instrument packages on deck. It is capable of undertaking cruises of up to ten days duration and ranges of 2,500 miles and is ice-strengthened for winter operations.

The *Mysis*, built in 1963, is a 50-foot vessel with accommodations for three scientists in common quarters. It is capable of cruises of three and one-half days duration and ranges of 800 miles. It has a single deckhouse lab of 75 square feet of clear deck space.

Besides the facilities specific to each department, the University of Michigan offers all the advantages of a major university. The Amdahl 470V/6 computer along with the Michigan Terminal System (MTS) operating system, and local software libraries provide outstanding computing capabilities. The library system includes over four million volumes and 350,000 periodicals. Special collections like the Engineering-Transportation Library of 300,000 volumes and the Natural Resources library and Great Lakes Research Division collection meet special needs of student in marine fields.

Also the University has a number of sites for research and field experience, including Camp Filibert Roth, in the western Upper Peninsula and the Biological Station in Cheboygan County wtih 9,000 acres and five miles of frontage on Douglas Lake.

The University also maintains relationships with federal and state agencies with facilities in Ann Arbor including the Michigan DNR Institute of Fisheries Research, the Great Lakes Fisheries Laboratory of the U.S. Fish and Wildlife Service, The NOAA Great Lakes Environmental Research Laboratory, and the Great Lakes Commission, Great Lakes Basin Commission and Great Lakes Fishery Commission.

ATMOSPHERIC AND OCEANIC SCIENCE

Facilities

The Department of Atmospheric and Oceanic Science includes laboratories for atmospheric and marine chemistry, synoptic meteorology, geophysical fluid dynamics, meteorological instrumentation, upper atmosphere studies, and facilities for general physical oceanography and marine geology. In addition, the Space Physics Research Laboratory is a part of this department.

Research activities of the faculty members and students in oceanography include: air-water interfacial phenomena, circulation and diffusion processes, sediments and sedimentation processes, geology of the Great Lakes basins, marine mineral exploration, biogeochemistry of sediments, coral reef ecology, ecology of plankton and benthic communities, and coastal circulation processes. Recent studies have been conducted in the Great Lakes region, the Caribbean, the Gulf of Alaska, the Atlantic coast, and the central Pacific. An active program in underwater operations is aimed at developing undersea research capabilities.

Oceanography staff of the Department participate in the Michigan Sea Grant Program and in cooperative research with scientists from the NOAA Great Lakes Environmental Research Laboratory.

The following degrees are offered:

1. Candidates for the degree of Bachelor of Science (Atmospheric and Oceanic Science) must complete the program listed below:

Subjects required by all programs (57 hours).

Mathematics 115, 116 and 117, 215 and 216	16
Humanities 101 and 102 - Great Books I and I	6
Engineering 102, Computing	2
Chemistry 123 or 124, and 125	5
Physics 140 with Lab. 141; 240 with Lab. 241	8
Seminars in Literature and Rhetoric	6
Humanities and Social Sciences	14

Advanced Science (3 hours).

Chemistry 126, Gen. and Inorganic Chemistry	3

Related Technical Subjects (12 hours).

Appl. Mech. 240, Intro. to Dynamics	4
Appl. Mech. 326, Fluid Mechanics	4
Chemistry 265, Princ. of Phys. Chem.	4

Program Subjects (6 hours).

A.&O. Sci. 304, Atmospheric and Oceanic Sciences I	3
A.&O. Sci. 305, Atmospheric and Oceanic Sciences II	3

Free Electives (6 hours).	6

Option 3, Oceanography (44 hours).

Geol. 218, Geology for Eng. (Note B)	3
Zool. 106, Intro. to Biology (Note B)	5
A.&O. Sci. 308, Lab. in Ocean. Data I	1
A.&O. Sci. 309, Lab. in Ocean. Data II	2
A.&O. Sci. 334, Physical Oceanography I	3
A.&O. Sci. 335, Physical Oceanography II	3
Elective Sequence in Oceanography (12-15 hours) (e.g., Biological, Chemical, Physical, Geological)	13
Technical Electives (11-16 hours) (Note C)	14
Total -	128

2. M.S. in Oceanic Science. An applicant for the M.S. degree in oceanic science is expected to hold a bachelor's degree and to have completed requirements in mathematics and physics. The bachelor's degree may be in any field of specialization, but students without undergraduate courses in oceanic science may be required to make up for this deficiency by completing undergraduate courses specified by their advisor.

Requirements for the degree include 30 credit hours of graduate studies approved by one of the graduate advisors, consisting of a minimum of at least 15 credit hours of coursework in oceanic science and a minimum of six credit hours of mathematics or three hours of mathematics and three hours of cognative science.

The student's program will be adjusted to assure that the student obtains some proficiency in each of several core subject matter areas. For oceanic science, these core areas are physical and dynamical oceanography, oceanographic observations and data analysis, marine chemistry and marine geology. Six hours of coursework in oceanic science may, after agreement with the graduate advisor, be replaced by a master's thesis.

3. Ph.D. in Oceanic Science. Applicants for the degree of Doctor of Philosophy in oceanic science are expected to have ability and scholarship of a high order. Students must be able to satisfy core requirements specified for the masters degree at a high level of competence and will elect additional courses to supplement their backgrounds and provide knowledge and techniques needed for carrying out independent investigations.

To satisfy the departmental requirements for candidacy, students must successfully pass a preliminary examination and must also satisfy the departmental language requirement of basic reading competence in French, German or Russian or substitute six hours of humanities or social science.

When the student has become a candidate, a dissertation committee will be appointed by the department chairperson. The subject of the dissertation may be in any area of oceanic science that is approved by the dissertation committee. A satisfactory oral examination of the candidate on the dissertation and related material, conducted by the dissertation committee, completes the requirements for the degree.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

203	The Oceans	3
304	Atmospheric and Oceanic Sciences I	3
305	Atmospheric and Oceanic Sciences II	
308	Laboratory in Oceanographic Data I	1
309	Laboratory in Oceanographic Data II	2
334	Physical Oceanography I	3
335	Physical Oceanography II	3
350	Ocean Engineering I	3
351	Geophysical Fluid Dynamics	3
360	Marine Environment	8

GRADUATE COURSES

404	Survey of Biological Oceanography	2
405	Survey of Geological Oceanography	2
406	Survey of Chemical Oceanography	2
407	Survey of Physical Oceanography	2
417	Geology of The Great Lakes	2
423	Biological Oceanography	3
428	Caribbean Marine Environments	3
429	Great Lakes Limnology Seminar	2
442	Ocean Dynamics I	3
449	Marine Geology	3
450	Ocean Engineering II	3
469	Underwater Operations	3
472	Experimental Marine and Mineral Geochemistry	2
473	Organic Geochemistry	3
478	Chemical Oceanography	3
501	Seminar in Limnology and Oceanography	1
526	Dynamics of the Oceans and Atmosphere	3
549	Structure and Tectonics of Ocean Basins	3
550	Ocean Engineering III	Arranged
559	Measurements in Physical Oceanography	3
572	Marine Geochemistry	3
701	Special Problems in Meteorology and Oceanography	Arranged
990	Dissertation/Precandidate	2-8, 1-4
995	Dissertation/Candidate	8, 4

FACULTY

In addition to the following faculty members of the Department of Atmospheric and Oceanic Science, the broad services of the entire University (including the general faculty) are accessible to the student. The instructional staff for the courses listed above are as follows:

Atreya, Sushil K., Ph.D., Assistant Professor
Ayers, John C., Ph.D., Professor
Baker, Dennis G., Ph.D., Associate Professor
Bartman, Frederick L., Ph.D., Professor and Associate Chairman
Beeton, Alfred M., Ph.D., Assistant Professor
Boyd, John P., Ph.D., Assistant Professor
Dingle A. Nelson, Sc.D., Professor
Donahue, Thomas M., Ph.D., Chairman and Professor
Draysón, S. Roland, Ph.D., Associate Professor
Gill, Gerlad C., M.A., Professor Emeritus
Hays, Paul B., Ph.D., Professor
Jacobs, Stanley J., Ph.D., Professor
Jones, Leslie M., B.S.E., Professor
Kuhn, William R., Ph.D., Professor
Meadows, Guy A., Ph.D., Assistant Professor
Meyers, Philip, Ph.D., Associate Professor
Nagy, Andrew, Ph.D., Professor
Owen, Robert M., Ph.D., Assistant Professor
Portman, Donald J., Ph.D., Professor
Rea, David K., Ph.D., Assistant Professor
Ryznar, Edward, M.S., Lecturer
Schelske, Clair L., Ph.D., Associate Professor
Somers, Lee H., Ph.D., Lecturer
Stedman, Donald, Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. Thomas M. Donahue, Chairman
Department of Atmospheric and Oceanic Science
2233 Space Research Building
The University of Michigan
Ann Arbor, Michigan 48109

NAVAL ARCHITECTURE AND MARINE ENGINEERING

Research Facilities

The department operates two model-testing facilities which are available for student projects at all levels. A well-equipped shop and staff are maintained. The towing tank is 360 feet long, with a cross-section of 22 feet by 10 feet. It is equipped with a carriage, a wavemaker, a beach, and a false bottom for shallow-water tests. The maneuvering basin is 60 feet by 100 feet by six feet. Waves makers are installed on one of the 60 foot sides, a beach on the opposite side, and a 14 foot wide towing carriage is also fitted along the adjacent wall. Equipment for radio control of models and telemetering is available.

The following degrees are offered:

1. Bachelor of Science in Engineering (Naval Architecture and Marine Engineering) - 71 degrees awarded in 1978-1979.

Requirements

Candidates for the degree of Bachelor of Engineering (Naval Architecture and Marine Engineering) -- B.S.E. (Nav. Arch. & Mar. E.) -- must complete the program listed below:

Subjects required by all programs (55 hours).

Mathematics 115, 116 and 117, 215, and 216	16
Humanities 101 and 102 - Great Books I and II	6
Engineering 102, Computing	2
Chemistry 123 or 124, and 125	5
Physics 140 with Lab. 141; 240 with Lab. 241	8
Seminars in Literature and Rhetoric	6
Humanities and Social Sciences	12

Advanced Mathematics (3 hours).

Elective	3

Related Technical Subjects (22 hours).

Eng. Graph. 101, Graphics	2
Mat.-Met. Engr. 250, Prin. of Eng. Materials	3
Appl. Mech. 211, Intro. to Solid Mechanics	4
Appl. Mech. 240, Intro. to Dynamics	4
Appl. Mech. 324 (Civ. Eng. 324), Fluid Mech.	3
Mech. Eng. 235, Thermodynamics I	3
Elec.-Comp. Eng. 314, Cct. Anal. and Electronics	3

Program Subjects (31 hours).

Nav. Arch. 200, Naval Arch. & Marine Eng.	2
Nav. Arch. 201, Form Calc. & Stability	3
Nav. Arch. 300, Computer Techniques in Naval Architecture	2
Nav. Arch. 310, Ship Strength I	4
Nav. Arch. 320, Ship Resistance & Propulsion I	4
Nav. Arch. 330, Ship Power Systems I	4
Nav. Arch. 340, Ship Dynamics I	4
Nav. Arch. 400, Maritime Eng. Management	2
Nav. Arch. 470, Ship Design I	3
Nav. Arch. 475, Design Project	3

Technical Electives (14 hours).
These must include at least two of the second courses in the four areas of concentration:

Nav. Arch. 410, Ship Strength II; Nav. Arch. 420, Ship Resistance & Propulsion II; Nav. Arch. 430, Ship Power Systems II; or Nav. Arch. 440, Ship Dynamics II	6
Plus another Elective in one of these areas of concentration	3
Plus other Electives	5

Free Elective (3 hours).

	3
Total -	128

2. M.S. and M.S.E. in Naval Architecture and Marine Engineering. Thirty-seven degrees were awarded in 1978-1979. The applicant should have a bachelor's degree (or equivalent education) in engineering, physics or mathematics. Preparation should include introductory courses in differential equations, solid mechanics, fluid mechanics and dynamics. Some experience with a large digital computer is desirable.

The 30 credit hours required for the degree will normally include at least 15 hours in naval architecture and marine engineering beyond those required for the bachelor's degree, as well as five or more hours of graduate-level mathematics courses.

There are no specific courses required of all students at this level. Most students will specialize in one or more of the following areas, including in their programs the basic courses specified: ship hydrodynamics, ship structures, marine engineering, ocean engineering or marine systems.

The programs leading to the M.S.E. degree are intended to train students for careers in design, shipyard practice and management. Applicants for these programs should have obtained the B.S.E. degree in naval architecture and marine engineering, or they should have some experience in the marine field in addition to a bachelor's degree in some other field than that of engineering. The M.S.E. degree is logically followed by one of the professional degrees. Students anticipating careers in research, development and teaching will normally work for the M.S. degree, which may then be followed by the Ph.D. degree.

The graduate advisor may allow certain courses in other departments to be used in partial fulfillment of the requirement of 15 hours in naval architecture and marine engineering, depending upon the background and goals of the individual student. The program in Marine Systems, Operations and Design is normally open only to applicants with a bachelor's degree or equivalent experience in the marine field.

3. Naval Architect, Marine Engineer (professional degrees - two degrees awarded in 1978-1979). The professional degree program requires a minimum of 30 credit hours of work beyond the M.S.E. level or its equivalent, taken at this unversity with a grade average of B or better. Successful completion of a qualifying examination for admission to candidacy is required.

The total graduate program shall include: at least 24 hours in the area of the department or program cited in the degree. The department or program advisors may specify these hours in greater detail. At least six hours devoted to research, design, or development problem, including a written report covering the work. A committee of faculty members will supervise the work, approve the report and conduct a final oral examination on his work. At least three courses in cognate fields other than mathematics. At least nine hours in mathematics beyond the B.S.E. mathematics requirements of the department cited in the degree.

4. Ph.D. (two degrees awarded in 1977-1978). The Ph.D. degree is conferred in recognition of marked ability and scholarship in some relatively broad field of knowledge. A part of the work consists of regularly announced graudate courses of instruction in the chosen field and in such cognate subjects as may be required by the student's committee. In addition, students must pursue independent investigations in some subdivision of the selected field and must present the results of their investigations in the form of a dissertation.

Students become applicants for the doctorate when they have been admitted to the Horace H. Rackham School of Graduate Studies and have been accepted in the field of specialization. No assurance is given that they become candidates for the doctorate until they have given evidence of superior scholarship and ability as original investigators.

There is no general course or credit requirement for the Ph.D. degree. Students must pass a comprehensive examination in their major field or specialization which tests their knowledge in that field and in the supporting fields before they will be recommended for candidacy for the doctorate. A special doctoral committee is appointed for each applicant to supervise the work of the student both as to election of courses and in preparation of the dissertation. A pamphlet that describes the general procedure leading to the doctorate can be obtained from the Graduate School office upon request, and another for this department specifically is also available.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

102	Introduction to Ship Systems	3
200	Naval Architecture and Marine Engineering	2
201	Form Calculations and Stability	3
300	Computer Techniques and Applications in Naval Architecture	2
310	Ship Strength I	4
320	Ship Resistance and Propulsion I	4
330	Ship Power Systems I	4
340	Ship Dynamics I	4
350	Ocean Engineering I	3

GRADUATE COURSES

400	Maritime Engineering Management	2
401	Small Craft Design	3
402	Small Commercial Vessel Design	3
403	Sailing Craft Design Principles	3
410	Ship Strength II	3
411	Finite Element Applications	3
420	Ship Resistance and Propulsion II	3
430	Ship Power Systems II	3
440	Ship Dynamics II	3
450	Ocean Engineering II	3
463	Nuclear Propulsion of Ships	3
469	Underwater Operations	3
470	Ship Design I	3
475	Design Project	3
490	Directed Study, Research, and Special Problems	Arranged
510	Ship Structure Analysis I	3
511	Special Topics in Ship Structure	Arranged
520	Ship Model Testing	Arranged
521	Special Topics in Ship Hydrodynamics	Arranged
525	Naval Hydrodynamics I	3
526	Naval Hydrodynamics II	3
530	Automatic Control in Naval Architecture and Marine Engineering	3
531	Marine Propulsion Plant Dynamics	3
535	Propulsion Plant Design Decisions	3
550	Ocean Engineering III	Arranged
571	Ship Design II	Arranged
572	Economics of Ship Design	3
573	Maritime Management	3
574	Computer-Aided Ship Design	3
590	Reading and Seminar in Marine Engineering	Arranged
591	Reading and Seminar in Naval Architecture	Arranged
592	Master's Thesis	3
610	Finite Element Methods	3
615	Ship Structure Analysis II	Arranged
620	Advanced Propeller Theory and Cavitation	2
625	Naval Hydrodynamics III	Arranged
792	Professional Degree Thesis	2-8
990	Dissertation/Pre-Candidate	2-8, 1-4
995	Dissertation/Candidate	8-4

The instructional staff for the courses listed above consists of the following:

Beck, Robert F., Ph.D., Associate Professor of Naval Architecture and Marine Engineering
Benford, Harry, B.S.E., Professor of Naval Architecture and Marine Engineering
Couch, Richard B., Ae.E., Professor of Naval Architecture and Marine Engineering

D'Arcangelo, Amelio M., M.S., Professor of Naval Architecture and Marine Engineering and Associate Chairman, Department of Naval Architecture and Marine Engineering
Kaldjian, Movses Jeremy, Ph.D., Professor of Naval Architecture and Marine Engineering
Latoure, Robert, Ph.D., Assistant Professor of Naval Architecture and Marine Engineering
Ogilvie, T. Francis, Ph.S., Professor of Fluid Mechanics and Chairman of the Department of Naval Architecture and Marine Engineering
Parsons, Michael G., Ph.D., Associate Professor of Naval Architecture and Marine Engineering
Vorus, William S., Ph.D., Associate Professor of Naval Architecture and Marine Engineering
Woodward, John B., III, Ph.D., Professor of Naval Architecture and Marine Engineering
Yagle, Raymond A., M.S.E., Professor of Naval Architecture and Marine Engineering

The following lecturers are also associated with the above courses:

Bunch, Howard M., M.B.A., Naval Architecture and Marine Engineering
Daoud, Nabil A.H., Ph.D., Naval Architecture and Marine Engineering
Mosher, Raymond F., S.M., P.E., Naval Architecture and Marine Engineering
Phelps, Vernon A., M.S.E., P.E., Naval Architecture and Marine Engineering
Troesch, Armin, Ph.D., Naval Architecture and Marine Engineering

Requests for further information or correspondence on individual problems regarding the undergraduate program should be addressed to:

Professor Raymond A. Yagle
Department of Naval Architecture and Marine Engineering
N.A.M.E. Building, North Campus
The University of Michigan
Ann Arbor, Michigan 48109

For information on graduate programs, write to:

Professor William Vorus
Department of Naval Architecture and Marine Engineering
N.A.M.E. Building, North Campus
The University of Michigan
Ann Arbor, Michigan 48109

SCHOOL OF NATURAL RESOURCES

(Highlighting specializations in fisheries and aquatic ecology)

The School of Natural Resources is located in the Samuel Trask Dana Building which offers 47,000 square feet of classrooms, laboratories and offices centrally located near the University General Library and the Natural Science Building.

Many natural resources courses are taught at the University of Michigan Biological Station or at Camp Filibert Roth.

Since professional employment in natural resource fields usually requires preparation beyond the Bachelor's Degree, the School of Natural Resources offers a basic curriculum that provides necessary background for further study in marine sciences, or fishery science, or aquatic ecology as well as offering masters and doctorate programs in natural resources areas.

The following degrees are offered:

1. Bachelor of Science in Natural Resources. The School of Natural Resources has prepared suggested study programs for students on the undergraduate level who wish to pursue an interest in marine sciences, including biological oceanography or marine biology or ecology; fisheries science; and natural resource ecology, including aquatic systems and biological oceanography.

For the specific requirements of each option, contact:

Undergraduate Counseling Office
1024 Dana
University of Michigan
Ann Arbor, Michigan 48109

2. Master of Science (Natural Resources). Master's students in Natural Resources normally affiliate with one of five programmatic areas: Environmental Education and Outdoor Recreation; Fisheries, Forestry, and Wildlife; Landscape Architecture; Resource Ecology; or Resource Policy and Management. Opportunities to develop master's level programs which combine components of two or more program areas are available. Degree requirements are flexible and permit selection of courses to meet individual needs.

FISHERIES, FORESTRY AND WILDLIFE MANAGEMENT

Master's students concentrate or have options in one or a combination of many specializations within the disciplines of fisheries, forestry, or wildlife management. The course of study is planned to meet the needs of the individual. Specializations might include: aquaculture, international resources management, management of recreation areas and fisheries, marine fishery development, natural resource biometry, water quality management, waterfowl management, watershed management and others.

Upon entering these areas of concentration, students will be expected to have a basic competence and balanced background in the biology-ecology, sociology, economic, quantification-inventory, and managerial concepts of renewable resource areas. This level of knowledge can be obtained by taking the recommended undergraduate program in one of these areas.

The graduate programs in fisheries are flexible enough to meet individual needs. The specific courses to be taken are chosen by the student in consultation with his or her advisor, and must be approved by the chairperson of the Fisheries-Forestry and Wildlife Program. A committee of at least two faculty members directs the student's program.

RESOURCE ECOLOGY

Coursework in the program consists of:

1. Distribution requirements to assure breadth in important areas of ecology.

2. Courses to provide training in a special area of interest to develop appropriate analytical techniques or to provide further work in basic biological or physical science.

Each student must complete graduate or senior-level courses in four of the following five areas of ecology: (1) systems ecology, (2) animal ecology, (3) plant ecology, (4) physiological ecology, and (5) aquatic ecology.

At the beginning of his or her graduate study the program of each student, specifically the proportion of credit hours in the distribution requirements above, must be defined in consultation with the faculty advisor and be approved by the Resource Ecology Program chairperson.

A committee consisting of at least two faculty members directs the student's program. The chairperson of the master's committee is ordinarily the student's major advisor and is the faculty member under whom the student wishes to concentrate his or her work. The other member or members are chosen to give a balanced and logical representation of interests involved in the program.

DOCTORAL PROGRAMS

The Doctor of Philosophy degree is awarded by the Horace H. Rackham School of Graduate Studies and may be earned for programs specializing in several areas of natural resources. A student may embark upon a doctoral program whether or not he or she has a professional degree in any natural resources field, but evidence must be given of adequate preparation in the proposed field of specialization.

Students in Natural Resources are normally expected to have completed requirements for the master's degree before admission to a doctoral program. Entering students with the B.S. degree who wish to obtain the Ph.D. are usually first admitted to a master's program which is tailored to prepare them for later doctoral work.

Evaluation of an applicant for the Doctor of Philosophy degree is normally based upon graduate academic performance, broad comprehension of the subject, and potential as an independent investigator. No applicant is accepted until a faculty member agrees to act as that student's major advisor. The major advisor serves as chairman of the student's candidacy committee that guides course selection and conducts the preliminary examinations. The candidacy committee is appointed by the Graduate Affairs Committee of the School of Natural Resources.

All doctoral students must elect, as graduate students, at least two graduate-level cognate courses that carry two or more credits each and have been approved by a graduate advisor. Cognate courses taken as a master's degree candidate may, with approval, satisfy the doctoral degree requirement.

After a student has completed the course requirements established by the candidacy committee, a preliminary examination is administered by the committee. After passing this examination, the student becomes a candidate for the doctorate and is eligible to proceed according to the rules stated in the Handbook for Doctoral Candidates, Horace H. Rackham School of Graduate Studies. All doctoral degrees require the completion of a dissertation in a format acceptable to the student's dissertation committee and the Dean of the Rackham Graduate School. The dissertation must be defended successfully in a comprehensive oral examination before the dissertation committee.

For information regarding admission, financial aid, or other details, write to the Admissions Office, Horace H. Rackham School of Graduate Studies, The University of Michigan, Ann Arbor, Michigan 48109. Correspondence should indicate the proposed field of specialization.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

NR 326	Elementary Aquatic Ecology	Arranged
NR 365	Social Basis of Resource Policy	3

GRADUATE COURSES

NR 411	Aquatic Ecology	4
NR 422	Biology of Fishes	2-4
NR 423	Biological Oceanography	3
NR 424	Physiology-Ecology of Fishes	3
NR 427	Aquaculture	2-3
NR 428	Caribbean Marine Environments	3
NR 429	Great Lakes Limnology	2
NR 459	International Studies Seminar	2
NR 460	Fishery Biology and Management	4
NR 461	Commercial Fisheries	2
NR 470	Natural Resource Economics	3
NR 472	Water Resource Economics	3
NR 516	Aquatic Entomology	4
NR 519	Advanced Fishery Management	3
NR 520	Seminar in Animal Diseases	3
NR 522	Energetic Correlates of Physiological and Ecological Adaptation of Animals	1
NR 524	Great Lakes Algae	2
NR 558	Water Resource Policy and Administration	3
NR 559	Political Theory and Resource Allocation	3
NR 638	Assessment of Animal Populations	2

The instructional staff for the courses listed above consists of the following:

SCHOOL OF NATURAL RESOURCES

Andrews, Richard N.L., Ph.D., Associate Professor of Resource Policy and Administration and Urban and Regional Planning, and Chairman, Resource Policy and Management
Beeton, Alfred M., Ph.D., Professor of Natural Resources, Professor of Atmospheric and Oceanic Science, and Director, Great Lakes and Marine Waters Center
Bulkley, Joathan W., Ph.D., Professor of Water Resources, SNR, and Professor of Civil and Water Resources Engineering
Cowan, Archibald B., Ph.D., Associate Professor of Wildlife Management and Director, Camp Filibert Roth
Drobney, Ronald D., Ph.D., Assistant Professor of Natural Resources
Fairfax, Sally K., Ph.D., Assistant Professor and Chairman of Resource Policy and Management
Gregory, G. Robinson, Ph.D., George Willis Pack Professor of Resource Economics, SNR, Research Associate, Center for aesearch on Economic Development

Hooper, Frank F., B.A., Professor of Fisheries, NSR, and Professor of Zoology
Jensen, Alvin L., Ph.D., Assistant Professor of Natural Resources
Lagler, Karl F., Ph.D., Justin W. Leonard Distinguished Professor of Natural Resources and Professor of Zoology
Marquis, Stewart D., Jr., A.M., Associate Professor of Resource Policy and Regional Planning
Schelske, Claire L., Research Limnologist, Great Lakes and Marine Water Center, Associate Professor of Natural Resources, Associate Professor of Limnology, Atmospheric and Oceanic Sciences
Schramm, Gunter, Ph.D., Professor of Resource Economics
Shapiro, Kenneth, Ph.D., Associate Professor of Natural Resources
Stapp, William B., Ph.D., Professor of Natural Resources
Stoermer, Eugene F., Ph.D., Associate Professor of Natural Resources and Research Scientist, Great Lakes and Marine Water Center
Vince, Susan W., Ph.D., Assistant Professor of Natural Resources
White, David S., Ph.D., Assistant Research Scientist, Great Lakes Research Division

INTERDISCIPLINARY PROGRAMS

Masters Degree in Marine and Lacustrine Geology

This is a cooperative arrangement between the Department of Atmospheric and Oceanic Science and the Department of Geology and Mineralogy. Applications for submission may be made through either department and will be considered from students with undergraduate degrees in the earth or physical sciences, oceanography, or engineering. Students admitted to the program will ordinarily concentrate in one of three areas: Marine Sedimentation, Marine Geophysics, or Marine Geochemistry. A minimum number of 32 credit hours and a thesis are required. A maximum of six hours in thesis research may be applied toward the total of 32 hours, and two required courses (A&OS 404 and Geol.-Min./A&OS 449) are common to the three options. Other requirements are specified for each option.

For further information contact:

Chairman, Department of Geology and Mineralogy
1006 C.C. Little Building
University of Michigan
Ann Arbor, Michigan 48109

or,

R. Owen
Atmospheric and Oceanic Science
Space Research Building
University of Michigan
Ann Arbor, Michigan 48109

Programs Under the University Water Resources Committee

Program Committee: Professor Weber (Civil Engineering), Chairman; Professors Beeton (Natural Resources/Atmospheric and Oceanic Science), Bulkley (Civil Engineering/Natural Resources), Cather (Biological Sciences), Hilbert (Environmental and Industrial Health), Mancy (Environmental and Industrial Health).

Program emphasis is placed on development of both technologic and socio-economic concepts required for solution of a variety of environmental and water resources problems.

The Water Resources Program coordinates four basic graduate programs: Water Resources Engineering (through the Department of Civil Engineering); Water Resources Management (described below); Water Resources Science (described below); and Health Aspects of Water Quality (through the Department of Environmental and Industrial Health). All four draw upon the educational facilities of the College of Engineering, School of Natural Resources, School of Public Health, Law School, and College of Literature, Science, and the Arts.

All students are assured personal counseling to help them select the program that will best meet their individual interests. Students considering graduate study in water resources should consult as early as possible with members of the interdepartmental Program Committee or write directly to Professor Walter J. Weber, Jr., Water Resources Program, Engineering Building 1-A, The University of Michigan, Ann Arbor, Michigan 48109.

The program leading to the degree M.S.E. in Civil Engineering: Water Resources is open to qualified candidates with a Bachelor of Science degree in any of the generally recognized fields of engineering. Program emphasis is placed on development of both technological and socio-economic concepts required for solution of a variety of environmental and water resources problems. Candidates for the degree M.S.E. must complete a minimum of 30 hours of graduate work, planned in consultation with the program advisor, constituting an integrated program. A typical program normally includes courses in: hydrology and water quantity management; water quality and water pollution control; water and wastewater treatment, water chemistry and limnology; air pollution and solid wastes control; systems analysis, operations research techniques, and computer applications; political and institutional factors in environmental and water resource systems.

INTERDEPARTMENTAL DEGREE PROGRAMS

Water Resources Management

Master of Science

The program in Water Resources Management provides the student with a working knowledge of problems and approaches for managing the use and development of water resources and provides specialization in one of the major aspects of water management through integrated training in technical, economic, social, and institutional aspects involved in public water management enterprises. It is designed for individuals seeking careers in governmental and quasi-public agencies concerned with water resources planning and development.

Water Resources Science

Master of Science

This program prepares the student in the fundamentals of scientific investigation of natural and

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polluted waters, emphasizing studies in the chemical and biological sciences and including cognate courses designed to broaden the student's perspective of the total water resources field. The program is intended for those seeking positions in research and pollution control laboratories, whether in industry or in federal, state, or local governments.

UNIVERSITY OF MINNESOTA
Minneapolis, Minnesota 55455

The University of Minnesota offers marine science related courses on the Twin Cities and Duluth Campuses and at the Itasca Biology Station. Courses are offered in a number of departments, and current information can be obtained from Bruce Munson, Marine Education Agent, Sea Grant Extension Program, 109 Washburn Hall, University of Minnesota-Duluth, Duluth, Minnesota 55812.

The Fisheries program is located on the St. Paul Campus in the Department of Entomology, Fisheries and Wildlife.

The following degrees are offered:

1. B.S. in Fisheries

   a) One hundred and ninety credits minimum.

2. M.S. in Fisheries

   a) Thesis plan - 28 credits minimum plus thesis.
   b) Nonthesis plan - 44 credits minimum plus research papers.

3. Ph.D. in Fisheries

   a) No credit minimum.
   b) Nine quarters registration.
   c) Thesis
   d) Preliminary and final examinations

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

FW	1001	Orientation in Fisheries and Wildlife	1
FW	3052	Introduction to Fisheries and Wildlife Biology and Management	4
Geo	1001	Physical Geology	5
AnSc	3301	Systemic Physiology	6
Bot	5231	Introduction to the Algae	5
or			
Bot	5811	Freshwater Algae	5
EBB	5601	Limnology	4

SENIOR-GRADUATE COURSES

FW	5279	Special Lectures in Fisheries	Arranged
FW	5280	Senior Seminar: Fisheries	1
FW	5393	Special Problems in Fishery Biology	Arranged
FW	5450	Techniques of Fishery Biology	4
FW	5451	Ecology of Fishery Populations	4
FW	5452	Fishery Management	4
FW	5454	Fishery Ecology of Polluted Waters	4
FW	5456	Field Ecology of Fishes (Itasca Biology Station only)	5

GRADUATE COURSES

FW	8200	Seminar	Arranged
FW	8364	Research in Fishery Biology	Arranged
FW	8448-8449	Fishery Biology	3
FW	8451	Production Biology of Fishery Environments	4

The instructional staff for the courses listed above from the Department of Entomology, Fisheries and Wildlife consists of the following:

Adelman, Ira A., Ph.D., Associate Professor
Spangler, George R., Ph.D., Associate Professor
Underhill, James C., Ph.D., Professor (Ecology and Behavioral Biology - joint appointment)
Waters, Thomas F., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. T[illegible]as F. Waters
Director of Graduate Studies in Fisheries
219 Hodson Hall
1980 Folwell Avenue
St. Paul, Minnesota 55108

UNIVERSITY OF MISSISSIPPI
University, Mississippi 38677

The University of Mississippi has research and teaching facilities in fresh water and marine sciences on the main campus at University. Selected classes are also taught at the Tupelo branch campus and the Universities Center in Jackson. Marine research is conducted by University scientists and the University is also affiliated with Mississippi's Gulf Coast Research Laboratory located at Ocean Springs, Mississippi. At the main campus facilities available consist of classrooms, offices, laboratories and computers.

The University is a part of the Mississippi-Alabama Sea Grant Consortium. It is this affiliation which provides the major emphasis for the present involvement of the University in marine science programs.

The following degrees or marine science related options are offered:

UNDERGRADUATE

School of Engineering: Bachelor of Science in Geological Engineering - marine geology option
Requirements: 135 semester hours.

College of Liberal Arts: Bachelor of Arts in Biology or Geology, or Bachelor of Science in Biology
Requirements: 126 semester hours.

GRADUATE

School of Engineering: Master of Science in Geology
Requirements: 30 hours of graduate credit, of which six will be thesis credits.

College of Liberal Arts: Master of Science in Geology
Requirements: 30 hours of graduate credit, of which six will be thesis credits;
Doctor of Philosophy
Requirements: Coursework requirements vary, one foreign language and dissertation required.

School of Law: Master of Marine Law and Science
Requirements: 30 hours of graduate credits, of which nine - 12 will be in specified marine related science - Prerequisites include a Bachelor of Science in one of the sciences plus a first degree in law.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

BIOL 101	General Biology
BIOL 103	Elementary Zoology
BIOL 105	Elementary Botany
BIOL 107	Elements of Wildlife Conservation
BIOL 207	General Ecology
BIOL 240	Introductory Aquatic Biology
BIOL 241	Introduction to Marine Biology
BIOL 441	Research Problems in Aquatic Biology
ENGR 302	Fluid Mechanics Laboratory
ENGR 321	Thermodynamics
ENGR 399	Thermodynamics
ENGR 322	Transport Phenomena
ENGR 311	Structures I
ENGR 312	Structures II
ENGR 411	Structures III
ENGR 412	Structures IV
ENGR 431	Soil Mechanics I
ENGR 432	Soil Mechanics II
ENGR 441	Fluid Mechanics
ENGR 101	Surface of the Earth
ENGR 213	Resources of the Earth
ENGR 215	Evolution of the Earth
ENGR 229	Invertebrate Paleontology
ENGR 235	Field Geology
ENGR 313	Sedimentology
ENGR 315	Stratigraphy
ENGR 435	Field Camp
ENGR 401	Thermo-Fluid Dynamics
ENGR 401	Fundamentals of Hydro- and Aero-Mechanics

GRADUATE COURSES

BIOL 557	Aquatic Microbiology
BIOL 559	Invertebrate Histology
BIOL 541	Marine Fisheries Biology
BIOL 551	Marine Botany
BIOL 560	Marine Invertebrate Zoology
BIOL 561	Marine Invertebrate Zoology
BIOL 562	Marine Vertebrate Zoology
BIOL 563	Parasites of Marine Animals
BIOL 565	Marine Microbiology
BIOL 567	Special Problems in Advanced Histology
BIOL 593	Problems in Zoology
CHEM 571	Biochemistry
CHEM 572	Biochemistry
CHEM 573	Selected Topics in Biochemistry
CHEM 574	Selected Topics in Biochemistry
ENGR 551	Engineering Thermodynamics
ENGR 501	Special Topics in Civil Engineering
ENGR 502	Special Topics in Civil Engineering
ENGR 531	Physical Marine Geology
ENGR 532	Chemical Marine Geology
ENGR 535	Geochemistry
ENGR 536	Geochemical Methods
ENGR 577	Geophysics I
ENGR 579	Geophysics II
ENGR 581	Applications in Geophysics
LAW 566	Natural Resources
LAW 581	Legal Control of Environment
LAW 675	Law of the Coastal Zone
LAW 676	Marine Science
LAW 620	International Law
LAW 628	Admiralty
LAW 615	Legal Research

Faculty involved in marine or marine related research are as follows:

BIOLOGY

Fritzsche, Ronald
Keiser, Edmund
Luther, Knight

CHEMISTRY

Hussey, Charles

GEOLOGY

Frederking, Ray
Manley, Fred
Minshew, Velon
Reynolds, William
Staheli, Albert

PHYSICS

Kelly, Robert

MECHANICAL ENGINEERING

Horton, Thomas

LAW RESEARCH CENTER

Criddle, Dixie
Hooper, William

To obtain further information, address inquiries to:

Dr. Donald E. Walsh
Associate Director of University Research
University of Mississippi
University, Mississippi 38677

UNIVERSITY OF NEW ENGLAND
SAINT FRANCIS COLLEGE
Biddeford, Maine 04005

St. Francis College, the undergraduate college of the University of New England offers four-year degree programs in Marine Biology and Environmental Analysis through its Center for Life Sciences. The 150-acre campus is located on the Saco River Estuary on the coast of Southern Maine. The programs utilize this location for intensive study of estuarine, open sea, salt marsh, mud flat, rocky and sandy beach environments. These environments provide habitat for a wide variety of plants, invertebrates, fish, birds and other marine organisms, for individual as well as class study.

Laboratory space of 2,500 square feet includes four preparation laboratories, seven teaching labs, numerous office and storage rooms. Equipment consists of electrophoresis units, environmental sampling devices, dredges, salinometer, bathythermograph, spectrophotometer, pH meters, a gas chromatograph, an otter trawl, seines and other types of fishing nets and gear, plankton nets, a temperature controlled tank room and an aquarium room. In addition, a wide variety of bacteriological and chemical laboratory equipment and facilities exist along with the usual microscopes, refrigerators, and freezers.

The College maintains its own research vessel, a 26-foot converted lobster boat, the Sawowcotuck.

Since our size and location do not permit an extensive research program, we encourage our students to gain experience, often along with academic credit by off-campus research placements. Those may be done through our Cooperative Education programs or during January Winter Term, internships or summer jobs.

Cooperative arrangements have been made in past years with students working with the Maine Department of Marine Resources, West Boothbay Harbor; Maine Department of Environmental Protection, Augusta; The Research Institute of the Gulf of Maine, Portland, Maine; Maine Department of Inland Fisheries and Wildlife; National Marine Fisheries Laboratories at Sandy Hook, New Jersey; Panama City, Florida; Milford, Connecticut; Beaufort, North Carolina; United States Environmental Protection Agency, Narragansett, Rhode Island; New England Aquarium, Boston, Massachusetts; Mystic Marine Life Aquarium, Mystic, Connecticut; American Museum of Natural History, New York City.

The following degree is offered:

1. Bachelor of Science in Marine Biology

The requirements for the Bachelor of Science in Marine Biology are:

110-111	General Chemistry
210-211	Organic Chemistry
200-201	Physics
150	Statistics
210	Calculus
140	Zoology
150	Botany
200	Genetics
210	Phycology
220	Invertebrate Biology
230	Ichthyology
380	Aquatic Ecology
360	Oceanography
290	Biological Research

In addition the student must choose one to three upper level biology courses in consultation with an academic advisor. Other college requirements in Liberal Learning, Human Services and Managerial Studies must also be completed to qualify for the degree.

The following courses are offered in conjunction with the above program:

Bi	110	General Biology
Bi	120	Field Biology
Bi	140	General Zoology
Bi	150	General Botany
Bi	180	The Environment and Man
Bi	200	Genetics
Bi	201	General Physiology
Bi	202	Comparative Vertebrate Anatomy
Bi	203	Histology
Bi	204	Parasitology
Bi	206	Embryology
Bi	210	Phycology
Bi	220	Invertebrate Zoology
Bi	225	Microbiology
Bi	230	Ichthyology
Bi	240	Ornithology
Bi	250	Animal Reproduction
Bi	260	Animal Behavior
Bi	290	Biological Topics
Bi	320	Fishery Biology
Bi	350	General Ecology
Bi	360	Oceanography
Bi	370	Environmental Analysis
Bi	375	Environmental Impacts
Bi	380	Aquatic Ecology
Bi	400	Biological Research
Ch	110-111	General Chemistry
Ch	210-211	Organic Chemistry
Ch	311	Analytical Chemistry
Phy	200-201	General Physics

The instructional staff for the courses listed above consists of the following:

CENTER FOR LIFE SCIENCES

Biology

Aplington, H.W., Ph.D., Professor
Bridges, David W., Ph.D., Associate Professor

Coleman, Douglas, Ph.D., Assistant Professor
Samuel, Gilbert, Ph.D., Associate Professor
Yuhas, Joseph, Ph.D., Associate Professor

Chemistry-Physics

Manyan, David, Ph.D., Associate Professor
Motz, Victor, Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. Joseph G. Yuhas, Director
Center for Life Sciences
University of New England/
Saint Francis College
605 Pool Road
Biddeford, Maine 04005
(207) 282-1515, Ext. 15

UNIVERSITY OF NEW HAMPSHIRE

Durham, New Hampshire 03824

The University of New Hampshire is well-located for marine science and ocean engineering activities in a variety of marine environments. The Great Bay estuarine system is adjacent to the campus while the coastline of the Atlantic is 15 miles away with the Isles of Shoals but a few miles offshore. The port city of New Hampshire, Portsmouth, is centrally located on the Gulf of Maine about 10 miles from the University.

The University's major marine facilities include the Jackson Estuarine Laboratory (JEL) on Great Bay, the Engineering Design and Analysis Laboratory (EDAL) and the Marine Program Building on campus, the Diamond Island facility on Lake Winnipesaukee 40 miles from campus, a research fleet composed of the 45-foot *Jere A. Chase* and several smaller craft and pier facilities at JEL and in Portsmouth near the ocean. These facilities are available to all marine faculty and students. The University, in cooperation with Cornell University and the State University of New York at Stonybrook, also has facilities at the Shoals Marine Laboratory on Appledore Island of the Isles of Shoals, this laboratory focusing on marine biology and related subjects.

Major items of equipment available include a circulating seawater system at JEL, electron microscopes, digital computers, a Beckman automatic amino acid analyzer, a liquid scintillation counter, a mass spectrometer, an auto analyzer, spectrophotometers, wave tanks and diving equipment. The *R/V Jere Chase* is equipped with radios, radar, Loran, an A-frame and carries portable research tools such as gravity coring devices and dredges.

Marine science and oceanographic educational and research programs involve the Departments of Biochemistry, Botany and Plant Pathology, Earth Sciences, Microbiology and Zoology while ocean engineering educational and research programs are conducted by the Departments of Chemical, Civil, Electrical and Mechanical Engineering. Additionally, marine research is also conducted by the Departments of Animal Sciences, Chemistry, Physical Education and Political Science as well as by the Resources Development Center and the Whittemore School of Business and Economics.

Marine research proceeds on both an intra and interdisciplinary basis being supported by such organizations as the National Sea Grant Program Office, the National Science Foundation, the Office of Naval Research, the National Institute of Health, U.S. Coast Guard, Woods Hole Oceanographic Institution and Sanders Associates among others. Research activities take faculty and students far afield to such places as the Arctic, Antarctic and mid-Pacific Oceans and the North Sea as well as to the neighboring marine environments of Great Bay and the Gulf of Maine. Examples of research studies include those relating to marine food chain, marine biotoxins, chemical, biological and thermal pollution, marine mineral resources, mariculture, marine resource management, marine law, environmental baseline data, arctic under-ice systems, diving systems, submersibles and underwater habitats. Many of these research activities are supported by an excellent diving program, which annually qualifies numerous faculty and student divers, in addition to facilities previously mentioned.

Information concerning degrees offered follows:

1. B.S., M.S. and Ph.D. in Biochemistry with specialization in marine biochemistry.

2. B.S., M.S. and Ph.D. in Botany with specialization in marine botany, granted by the Department of Botany and Plant Pathology.

   a) B.S. Non-thesis degree requiring a minimum of 128 credits.
   b) M.S. Thesis degree requiring a minimum of 30 credits and defense of a thesis based on field or lab research.
   c) Ph.D. Doctoral dissertation degree requiring oral qualifying exam, defense of dissertation, a reading knowledge of at least one foreign language and, possibly, proficiency in a cognate field such as computer techniques.

3. B.S. and M.S. in Chemical Engineering with specialization in ocean engineering, granted by the Department of Chemical Engineering.

   a) B.S. Non-thesis degree requiring a minimum of 131 credits. See Ocean Engineering Minor Program.
   b) M.S. Thesis or non-thesis degree requiring a minimum of 30 credits. Thesis may be waived by reason of previous research.
   c) Ph.D. See Ph.D. in Engineering.

4. B.S. and M.S. in Civil Engineering with specialization in ocean engineering, granted by the Department of Civil Engineering.

   a) B.S. Non-thesis degree requiring a minimum of 131 credits. See Ocean Engineering Minor Program.
   b) M.S. Thesis or project degree, the thesis degree requiring a thesis and 24 credits and the

project degree requiring a written paper on a projects course in addition to 30 credits of coursework.

c) Ph.D. See Ph.D. in Engineering.

5. B.A. and B.S. in Geology and B.A. Science Major with Earth Science Concentration with specialization in the marine earth sciences, granted by the Department of Earth Sciences.

a) B.A. in Geology. Non-thesis degree requiring a minimum of 128 credits, 32 credits being in the Earth Sciences.

b) B.S. in Geology. Non-thesis degree requiring a minimum of 128 credits, 48 credits being in the Earth Sciences.

c) B.A. Science Major. Non-thesis degree requiring a minimum of 128 credits, 24 credits being in the Earth Sciences.

6. M.S. in Earth Sciences -- Oceanography requires a major in geology, chemistry, physics, mathematics, engineering, or in the biological sciences, and requires completion of one year of college chemistry, calculus and physics. Undergraduate preparation will determine the area of specialization for the masters program. Students must complete as specific curriculum, including an Earth Sciences graduate seminar, two or more courses related to their specialty and a Master's thesis. An oral presentation of the thesis is made to the department.

7. M.S. in Geology with specialization in one area of oceanography, granted by the Department of Earth Sciences.

Thesis degree requiring a minimum of 30 credits and an oral or written examination on thesis work.

8. B.S. and M.S. in Electrical Engineering with specialization in ocean engineering, granted by the Department of Electrical and Computer Engineering.

a) B.S. Non-thesis degree requiring a minimum of 129 credits. See Ocean Engineering Minor Program.

b) M.S. Thesis or independent research degree, unless waived by reason of equivalent experience, requiring a minimum of 30 credits.

c) Ph.D. See Ph.D. in Engineering.

9. Ph.D. in Engineering with specialization in ocean engineering in the areas of Engineering Systems Design, Signal Processing, Theoretical and Applied Mechanics and Transport Phenomena, granted by the Engineering Ph.D. Program representing the Departments of Chemical, Civil, Electrical and Computer, and Mechanical Engineering.

A doctoral dissertation degree requiring a qualifying examination, defense of dissertation, a reading knowledge of at least one foreign language or, possible, a proficiency in a cognate field such as computer techniques in addition to prescribed coursework.

10. B.S. and M.S. in Mechanical Engineering with specialization in ocean engineering, granted by the Department of Mechanical Engineering.

a) B.S. Non-thesis degree requiring a minimum of 128 credits.

b) M.S. Thesis or project degree, the thesis degree requiring a thesis and 24 credits of coursework and the project degree requiring a project and 30 credits of coursework. Individuals with special qualifications may be excused from the project.

c) Ph.D. See Ph.D. in Engineering.

11. B.A., M.S. and Ph.D. in Microbiology with specialization in marine microbiology, granted by the Department of Microbiology.

a) B.A. Non-thesis degree requiring a minimum of 128 credits.

b) M.S. Thesis degree requiring a minimum of 30 credits and an oral examination on thesis and graduate coursework.

c) Ph.D. Doctoral dissertation degree requiring oral qualifying examination, defense of dissertation, reading proficiency in one foreign language and one semester of teaching or previous equivalent experience.

12. B.A., M.S. and Ph.D. in Zoology with specialization in marine zoology, granted by the Department of Zoology.

a) B.A. Non-thesis degree requiring a minimum of 128 credits.

b) M.S. Thesis or special problem degree requiring a minimum of 30 credits and an oral examination on thesis and graduate coursework.

c) Ph.D. Doctoral dissertation degree requiring oral qualifying examination, defense of dissertation and written examination demonstrating proficiency in at least one foreign language.

The following courses are offered in conjunction with the above programs:

BIOCHEMISTRY (Biochem.)

702	Comparative Marine Biochemistry	2
795, 796	Investigations in Biochemistry	2
899	Master of Science Thesis	6-10
999	Doctoral Research	

BOTANY

525	Introduction to Marine Botany	4
666	Summer Flora of New Hampshire	4
721	The Microscopic Algae	4
722	Marine Phycology	4
723	Marine Algal Ecology	4
727	Algal Physiology	2
729	Algal Physiology Laboratory	2
822	Advanced Marine Phycology	4
899	Master of Science Thesis	6-10
999	Doctoral Dissertation	

CHEMICAL ENGINEERING (Ch.E.)

695	Chemical Engineering Project	2-4
899	Master's Thesis	1-6

CHEMISTRY

517	Quantitative Analysis	3
518	Quantitative Analysis Laboratory	2
699	Thesis	4/semester
830	Advanced Optical Methods	3
833	Chemical Separations	3

899	Thesis -- Problems in Chemistry	Various
999	Doctoral Research	

CIVIL ENGINEERING (C.E.)

695	Civil Engineering Projects	2-4
757	Coastal Engineering and Processes	4
899	Master's Thesis	6-9

DEPARTMENT OF EARTH SCIENCES (E.S.)

501	Introduction to Oceanography	4
502	Introduction to Oceanography Laboratory	1
503	Introduction to Marine Science	4
561	Geomorphology	4
652	Invertebrate Paleontology	4
741	Geochemistry	4
752	Chemical Oceanography	3-4
754	Sedimentation - Stratigraphy	4
758	Introduction to Physical Oceanography	4
759	Geological Oceanography	4
795	Topics in the Earth Sciences	4
816	Mineralogy of Clays	3
841	Analytical Geochemistry	3
856	Estuarine and Marine Sedimentation	3
858	Dynamical Oceanography	4
859, 896	Topics in the Earth Sciences	1-4
899	Earth Sciences Master's Thesis	6-10

ELECTRICAL AND COMPUTER ENGINEERING (E.E.)

695	Electrical Engineering Projects	4
781	Ocean Instrumentation Project	4
785	Underwater Acoustics	4
796	Special Topics in Electrical Engineering	2-4
899	Master's Thesis	6

ENGINEERING Ph.D. PROGRAM

999	Doctoral Research

MECHANICAL ENGINEERING (M.E.)

508	Fluid Dynamics	4
695-696	Mechanical Engineering Undergraduate Projects and Independent Study	2-4
707	Analytical Fluid Dynamics	4
737	Ocean Mechanics I	4
738	Ocean Mechanics II	4
751	Naval Architecture in Ocean Engineering	4
752	Submersible Vehicle Systems Design	4
757	Coastal Engineering and Processes	4
807	Compressible Fluid Flow	4
808	Theoretical Aero/Hydro-Mechanics	4
838	Theoretical Acoustics	4
899	Master's Thesis	6-10

MICROBIOLOGY (Micro.)

600	Environmental Microbiology	4
707	Marine Microbiology	4
708	Microbial Biogeochemistry	4
795-796	Problems in Microbiology	4
899	Master's Thesis	6-10
999	Doctoral Research	

TECHNOLOGY (Tech.)

610	Introduction to Ocean Engineering	4
697	Ocean Projects	2/semester

ZOOLOGY (Zoo.)

528	Introductory Invertebrate Zoology	4
537	Comparative Invertebrate Physiology	4
620	Introductory Marine Science for Teachers	1
628	Developmental Biology of the Invertebrates	4
704	Comparative Endocrinology	4
711	Natural History of Cold-Blooded Vertebrates	4
715	Natural History of Marine Invertebrates	4
724	Marine Parasitology	4
772	Fisheries Biology	4
774	Introduction to Marine Science (Offered at the Shoals Marine Laboratory in cooperation with Cornell University and State University of New York/Stonybrook)	5
775	Invertebrate Embryology	4
777	Introduction of Neurobiology	4
778	Comparative Neurophysiology	4
795-796	Special Problems in Zoology	2-4
803	Marine Ecology	4
815	Population Ecology	4
820-821	Advanced Invertebrate Zoology	4
822	Protozoology	4
826	Comparative Physiology	4
895-896	Advanced Studies in Zoology	4
899	Master's Thesis	6
999	Doctoral Research	

Faculty of the several departments, institute and school associated with the University's Marine Program are as follows:

BIOCHEMISTRY

Green, Donald M., Ph.D., Professor of Biochemistry
Herbst, E.J., Ph.D., Professor of Biochemistry
Ikawa, M., Ph.D., Professor of Biochemistry
Klippenstein, G.L., Ph.D., Associate Professor of Biochemistry
Shimer, Stanley R., Ph.D., Emeritus Professor of Biochemistry
Smith, Samuel C., Ph.D., Professor of Biochemistry
Stewart, James A., Ph.D., Associate Professor of Biochemistry (Department Chairman)
Teeri, Arthur E., Ph.D., Professor of Biochemistry

BOTANY

Kingsbury, John M., Ph.D., Adjunct Professor of Botany
Mathieson, Arthur C., Ph.D., Professor of Botany

CHEMICAL ENGINEERING

Fan, S.T., Ph.D., Associate Professor of Chemical Engineering
Farag, Ihab H., Assistant Professor of Chemical Engineering
Lavine, Irvin, Ph.D., Emeritus Professor of Chemical Engineering
Mathur, V.K., Ph.D., Assistant Professor of Chemical Engineering

Sundberg, Donald C., Assistant Professor of Chemical Engineering
Ulrich, Gail D., Associate Professor of Chemical Engineering
Zimmerman, Oswald T., Ph.D., Emeritus Professor of Chemical Engineering

CHEMISTRY

Amell, Alexander R., Ph.D., Professor of Chemistry
Andersen, K.K., Ph.D., Professor of Chemistry
Chasteen, N.D., Ph.D., Assistant Professor of Chemistry
Grant, C.L., Ph.D., Professor of Chemistry
Haendler, Helmut M., Ph.D., Professor of Chemistry
Hubbard, Colin D., Associate Professor of Chemistry
Jones, Paul R., Ph.D., Professor of Chemistry
Morrison, James D., Ph.D., Professor of Chemistry
Owens, Charles W., Ph.D., Professor of Chemistry
Pilar, Frank L., Ph.D., Professor of Chemistry
Sawyer, Albert K., Ph.D., Professor of Chemistry
Seitz, W. Rudolf, Assistant Professor of Chemistry
Uebel, J.J., Ph.D., Associate Professor of Chemistry
Weber, James H., Ph.D., Professor of Chemistry
Weisman, Gary R., Assistant Professor of Chemistry
Wheeler, Charles M., Ph.D., Professor of Chemistry
Wong, Edward H., Assistant Professor of Chemistry

CIVIL ENGINEERING

Batchelder, Gerald M., Adjunct Associate Professor of Civil Engineering
Bishop, Paul L., Associate Professor of Civil Engineering (Department Chairman)
Chu, Yen-hsi, Assistant Professor of Civil Engineering
Dawson, Charles O., Ph.D., Emeritus Professor of Civil Engineering
DeAlba, Pedro A., Assistant Professor of Civil Engineering
Goodspeed, Charles H., Associate Professor of Civil Engineering
Gress, David L., Assistant Professor of Civil Engineering
Klotz, Louis H., Associate Professor of Civil Engineering
Moynihan, Robert P., Adjunct Assistant Professor of Civil Engineering
O'Brien, Dennis J., Assistant Professor of Civil Engineering
Olofsson, John A., Assistant Professor of Civil Engineering
Ossenbruggen, Paul J., Associate Professor of Civil Engineering
Skelton, Russell R., Ph.D., Emeritus Professor of Civil Engineering
Vreeland, Robert P., Emeritus Associate Professor of Civil Engineering
Wang, Tung-Ming, Ph.D., Professor of Civil Engineering

EARTH SCIENCES

Anderson, F.E., Ph.D., Associate Professor of Geology
Birch, F.S., Ph.D., Assistant Professor of Earth Sciences
Bothner, W.A., Ph.D., Associate Professor of Geology
Brown, W.S., Ph.D., Assistant Professor of Earth Sciences
Chapman, Donald H., Ph.D., Emeritus Professor of Earth Sciences
Davis, Robert I., Ph.D., Adjunct Professor of Earth Sciences
Gaudette, Henri E., Ph.D., Professor of Earth Sciences
Loder, T.C., Ph.D., Assistant Professor of Earth Sciences
Mayewski, Paul A., Assistant Professor of Earth Sciences
Meyers, T. Ralph, Ph.D., Emeritus Professor of Earth Sciences
Schneer, Cecil J., Ph.D., Professor of Earth Sciences
Stewart, Glenn W., Associate Professor of Earth Sciences
Tischler, H., Ph.D., Professor of Geology

ELECTRICAL AND COMPUTER ENGINEERING

Blanchard, F.A., M.S., Professor of Electrical and Computer Engineering
Cannon, Michael R., Assistant Professor of Electrical and Computer Engineering
Clark, Ronald R., Ph.D., Professor of Electrical and Computer Engineering (Department Chairman)
Darlington, Sidney W., Adjunct Professor of Electrical and Computer Engineering
Frost, A.D., B.S., Professor of Electrical and Computer Engineering
Gerhard, G.C., Ph.D., Associate Professor of Electrical and Computer Engineering
Glanz, F.H., Ph.D., Associate Professor of Electrical and Computer Engineering
Hitchcock, Leon W., Ph.D., Professor of Electrical and Computer Engineering
Hraba, John B., Ph.D., Professor of Electrical and Computer Engineering
Kraft, Gordon, Assistant Professor of Electrical and Computer Engineering
Melvin, D.W., Ph.D., Associate Professor of Electrical and Computer Engineering
Murdoch, J.B., Ph.D., Professor of Electrical and Computer Engineering
Nahin, Paul J., Assistant Professor of Electrical and Computer Engineering
Pokoski, John L., Associate Professor of Electrical and Computer Engineering
Rogerts, Dana B., Assistant Professor of Electrical and Computer Engineering
Sivaprasad, K.U., Ph.D., Associate Professor of Electrical and Computer Engineering
Stotz, K.C., Ph.D., Associate Professor of Electrical and Computer Engineering
Winn, A.L., S.M., Professor of Electrical and Computer Engineering

MECHANICAL ENGINEERING

Allmendinger, E.E., M.S., Associate Professor of Naval Architecture
Beasley, Wayne M., Associate Professor of Mechanical Engineering
Celikkol, B., Ph.D., Assistant Professor of Mechanical Engineering
Clark, William E., Assistant Professor of Mechanical Engineering
Corell, R.W., Ph.D., Professor of Mechanical Engineering

Emery, Harvard B., Assistant Professor of Mechanical Engineering
Hochgraf, Frederick G., Associate Professor of Mechanical Engineering
Limbert, D.E., Ph.D., Associate Professor of Mechanical Engineering
Mosberg, William, Associate Professor of Mechanical Engineering (Department Chairman)
Savage, G.H., Ph.D., Professor of Mechanical Engineering
Stolworthy, E.H., Dr. Eng. (H), Emeritus Professor of Mechanical Engineering
Swift, M. Robinson, Assistant Professor of Mechanical Engineering
Taft, C.K., Ph.D., Professor of Mechanical Engineering
Valentine, Russell L., Associate Professor of Mechanical Engineering
Wilson, John A., Associate Professor of Mechanical Engineering
Yildiz, Muse, Senior Research Fellow and Lecturer

MICROBIOLOGY

Balkwill, David L., Assistant Professor of Microbiology
Blakemore, Richard P., Assistant Professor of Microbiology
Chesbro, William R., Ph.D., Professor of Microbiology
Jones, G.E., Ph.D., Professor of Microbiology
Metcalf, T.G., Ph.D., Professor of Microbiology
Pistole, T.G., Ph.D., Assistant Professor of Microbiology
Slanetz, Lawrence W., Ph.D., Emeritus Professor of Microbiology
Zsigray, Robert M., Associate Professor of Microbiology

TECHNOLOGY

Davis, Richard, Dean

ZOOLOGY

Borror, A.C., Ph.D., Professor of Zoology
Bullock, W.L., Ph.D., Professor of Zoology
Croker, R.A., Ph.D., Associate Professor of Zoology
Foret, John E., Associate Professor of Zoology (Department Chairman)
Francq, Edward N., Assistant Professor of Zoology
Haney, James F., Associate Professor of Zoology
Harris, L.G., Ph.D., Assistant Professor of Zoology
Hoornbeek, F.K., Ph.D., Associate Professor of Zoology and Genetics
Lavoie, Marcel E., Associate Professor of Zoology
Lumsden, Abigail R., Lecturer in Zoology
Milne, Lorus J., Ph.D., Emeritus Professor of Zoology
Richardson, Edythe T., Ph.D., Emeritus Professor of Zoology
Sasner, J.J., Ph.D., Associate Professor of Zoology
Sawyer, P.J., Ph.D., Professor of Zoology
Schaefer, Paul E., Emeritus Associate Professor of Zoology
Smith, R.M., Ph.D., Assistant Professor of Zoology
Swan, Emery F., Ph.D., Emeritus Professor of Zoology
Taylor, James T., Assistant Professor of Zoology
Tillinghast, Edward K., Associate Professor of Zoology
Walker, Charles W., Assistant Professor of Zoology
Watson, Winsor H., III, Assistant Professor of Zoology

To obtain further information, address inquiries to:

Associate Director
University of New Hampshire Marine Program
University of New Hampshire
Marine Program Building
Durham, New Hampshire 03824
(603) 862-1383

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Chapel Hill, North Carolina 27514

The University of North Carolina has teaching and research facilities on the campus at Chapel Hill, at the Institute of Marine Sciences at Morehead City, and at the Wrightsville Marine Biomedical Laboratory, Wilmington. Courses are taught on campus in several departments and research projects are also conducted in departmental laboratories. Special research facilities on campus include Uniboomer sub-bottom profiling system, Salinity/Temperature/Depth profiling system, radio tracked current drogue, Radium-226/Radon-222 isotope counting system; biological incubators; electron microscopes, gas chromatographs, infrared spectrometer; gamma spectrometer; mass spectrometer, liquid scintillation counters, and computer center. The principal research facility is the Institute of Marine Sciences. A new laboratory building providing 20,000 square feet of space was completed on the shore of Bogue Sound in 1968. The R/V Machapunga, a 48-foot diesel-powered vessel specially built for estuarine research, is equipped with radiotelephone, fathometer, generators for 100 volt a.c. and 32 volt d.c., and a hydraulic winch for handling gear; it has a 600-mile cruising range and living accommodations for four persons. Several outboard-powered small boats are available.

Additional facilities at this coastal laboratory include a library, research collections of fishes, decapod crustaceans, and mollusks, photographic darkroom, radio-isotope facilities, a large pier, a running saltwater system in a separate wing of the laboratory, large outdoor seawater tanks, and experimental seawater ponds. Research equipment includes microscopes, in situ salinometers, sampling bottles, nets and trawls, pyrheliometers, submarine photometer, oxygen and carbon dioxide analyzers, histological equipment, gas chromatograph, spectrophotometers, and many other types of general laboratory equipment.

Special equipment at Wrightsville Marine Biomedical Laboratory include pressure chambers to simulate terrestrial environments from +30,000 to -6,000 feet above sea level, together with apparatus and instrumentation for physiological and neurological studies; special problems in physical chemistry and strength of materials can also be undertaken.

The following degrees are offered:

1. Ph.D. in Marine Sciences (Curriculum in Marine Sciences). For the Ph.D. degree each student will ordinarily take at least four of the following courses: Oceanography, Physical Oceanography, Geological Oceanography, Biological Oceanography and Chemical Oceanography, although his committee may approve other courses as satisfactory substitutes. He must also take Seminar in Marine Sciences at least twice and will study or do research at a marine laboratory or on an oceanographic cruise in a program approved by his committee. The dissertation will be on a marine topic. A minor is optional. A reading knowledge of one foreign language is required. Every student must gain some teaching experience during his program.

2. M.S. in Marine Sciences (Curriculum in Marine Sciences). For the M.S. degree each student must earn at least 30 semester hours of credit, including the four core courses in physical, biological, chemical and geological oceanography degree or substitute courses that are satisfactory to his committee. He must take Seminar in Marine Sciences at least once, and a period of residence at a marine station or on an oceanographic cruise will ordinarily be required. A thesis on a marine topic is required. A minor is optional. Every student must gain some teaching experience during his program.

The following courses are offered in conjunction with the above programs:

GRADUATE

CURRICULUM IN MARINE SCIENCES

101	Oceanography	3
103	Geological Oceanography	4
104	Biological Oceanography	4
105	Chemical Oceanography	4
122	Physical Oceanography	4
137	Ecology of Coastal Wetlands	6
141s	Special Problems in Marine Biology	6
161s	Problems in Marine and Environmental Physiology	2
206	Seminar in Oceanography	1
222	Advanced Physical Oceanography	3
225	Physical Oceanography Seminar	2
239	Micropaleontology -- Foraminifera	4
268	Marine Geophysics	4
300	Research in Marine Sciences	2-up
393	Master's Thesis	3-up
394	Doctoral Dissertation	3-up

DEPARTMENT OF BOTANY

114	Algae	5
215	Marine Mycology	6
216	Marine Phycology	5
219	Algal Physiology	5

DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING

122	Water Chemistry	4
132	Limnology and Water Pollution	3
134	Environmental Microbiology	3
233	Microbial Ecology	4
245	Ecology of Phytoplankton	4

DEPARTMENT OF GEOLOGY

151	Geodynamics	3
180	Applied Geophysics	4
181	Applied Geophysics	4
221	Sedimentary Petrology	4
225	Advanced Sedimentation	4
227	Clay Mineralogy	4
250	Low Temperature Geochemistry	3

DEPARTMENT OF ZOOLOGY

109	Introduction to Hydrobiology	4
134	Invertebrate Development, Larvae, and Plankton	4
146	Marine Ecology	4
156	Advanced Marine Invertebrate Zoology	4
157	Advanced Marine Invertebrate Zoology	4
208	Population Ecology	3
213	Advanced Marine Ecology	3
265	Seminar in Marine Biology	2

The instructional staff for the courses listed above consists of the following:

CURRICULUM IN MARINE SCIENCES

Adey, Walter H., Ph.D., Adjunct Professor (Coralline Algae)
Bane, John M., Ph.D., Assistant Professor (Physical Oceanography)
Frankenberg, Dirk, Ph.D., Professor (Biological Oceanography)
Martens, Christopher S., Ph.D., Assistant Professor (Chemical Oceanography)
McIntyre, Ian G., Ph.D., Adjunct Associate Professor (Carbonate Geology)
Neumann, Conrad A., Ph.D., Professor (Geological Oceanography)
Williams, Austin B., Ph.D., Adjunct Professor (Decapod Crustacea)

DEPARTMENT OF BOTANY

Hommersand, Max H., Ph.D., Associate Professor

DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING

Johnson, J. Donald, Ph.D., Professor of Environmental Chemistry
Kuenzler, Edward J., Professor of Environmental Biology
Pfaender, Frederick K., Ph.D., Assistant Professor of Environmental Biology
Shuman, Mark S., Ph.D., Assistant Professor of Environmental Chemistry
Weiss, Charles M., Ph.D., Professor of Environmental Biology

DEPARTMENT OF GEOLOGY

Carter, Joseph G., Ph.D., Assistant Professor
Ingram, Roy L., Ph.D., Professor
Rogers, John J.W., Ph.D., Professor
St. Jean, Joseph, Jr., Ph.D., Professor
Textoris, Daniel A., Ph.D., Associate Professor
Wheeler, Walter Hall, Ph.D., Professor

DEPARTMENT OF ZOOLOGY

Jenner, Charles E., Ph.D., Professor
Lehman, Harvey E., Ph.D., Professor
McMahan, Elizabeth A., Ph.D., Professor
Riece, Seth, Ph.D., Associate Professor
Rieger, Reinhard M., Ph.D., Assistant Professor

DENTAL RESEARCH CENTER

Crenshaw, Miles, Ph.D., Professor

INSTITUTE OF MARINE SCIENCES

Chestnut, Alphonse F., Ph.D., Director of the Institute of Marine Sciences, Professor of Zoology
Fahy, William E., Ph.D., Professor
Neumann, A. Conrad, Ph.D., Professor
Paerl, Hans W., Ph.D., Assistant Professor
Peterson, Charles H., Ph.D., Associate Professor
Schwartz, Frank J., Ph.D., Professor

WRIGHTSVILLE MARINE BIOMEDICAL LABORATORY

Brauer, R.W., Ph.D., Director, Professor

To obtain further information, address inquiries to:

Dr. Dirk Frankenberg, Chairman
Curriculum in Marine Sciences 045A
University of North Carolina
Chapel Hill, North Carolina 27514

UNIVERSITY OF NORTH CAROLINA AT WILMINGTON
Wilmington, North Carolina 28403

The University of North Carolina at Wilmington, located on a 600-acre campus adjacent to the Atlantic Ocean, Intracoastal Waterway and Cape Fear River Estuary, has marine research and teaching facilities on its main campus as well as specialized research facilities at its Institute for Marine Biomedical Research at Wrightsville Beach. The principal facility used for marine science programs on campus is the 40,000 square foot Marine Sciences Building which presently houses the Department of Biology and Earth Sciences and the Program for Environmental Studies. It contains several classrooms, 14 teaching and research laboratories, specialized equipment and work areas, and conference rooms. The Institute for Marine Biomedical Research is housed in an aggregate of four buildings totaling 12,000 square feet. More than a dozen specialized laboratories and various supporting facilities, including an instrument and machine shop and animal quarters, are provided. The University also owns a fleet of 10 boats ranging from 14 to 23 feet in length, and is currently negotiating the acquisition of a 73-foot trawler to be used for research. Vessels are berthed at the University-leased marina at Wrightsville Beach, a few minutes drive from the campus.

Marine-related academic programs include a marine biology curriculum leading to the B.S. degree, and an environmental studies curriculum with an emphasis in marine sciences leading to the B.A. degree. (The University is currently planning a Master of Science program in Marine Biology with an anticipated implementation date in 1980.)

The marine biology curriculum includes a basic introduction to the field of biology with an emphasis at the upper level in various aspects of marine biology. The environmental studies curriculum is a multi-disciplinary one in which students may elect to emphasize marine sciences. This curriculum is designed to expose the student to a broad range of research procedures in the natural and social sciences while allowing each student to develop in-depth capabilities in marine science.

The following UNC-W degrees are offered:

1. B.S. in Marine Biology

    a) At least 37 semester hours in biology and marine biology
    b) Year courses in general chemistry and physics
    c) Precalculus or calculus
    d) Additional physical science electives

2. B.A. in Environmental Studies with a concentration in marine sciences

    a) Introduction to the environment and environmental studies senior seminar
    b) Statistics and computer sciences
    c) Four natural sciences environmental courses
    d) Three social sciences environmental courses
    e) A minimum of 20 semester hours in upper marine sciences courses

Degrees granted in the 1978-1979 academic year: Fifty-nine B.S. degrees in Marine Biology and 16 B.A. degree in Environmental Studies with a concentration in Marine Sciences.

The following Marine Sciences courses are offered:

BIO	362	Marine Biology	3
BIO	365	Invertebrate Zoology	4
BIO	366	Ecology	3
BIO	446	Phycology	4
BIO	456	Ornithology	4
BIO	457	Ichthyology	4
BIO	458	Fisheries Biology	4
BIO	466	Advanced Ecology	4
BIO	468	Planktonology	4
BIO	491	Directed Individual Study (on marine topics)	1-3
BIO	495	Seminar (Deep Sea Biology, Marine Mammals, Sharks, Fishes, etc.)	1

ERS	205	Oceanography	3
ERS	217	Sedimentary Petrology	4
ERS	305	Marine Geology	4
ERS	490	Research in Earth Sciences (related to the marine environment)	3
ERS	491	Directed Individual Study (on marine topics)	1-3
CHEM	333	Analytical Chemistry in Environmental Problems	3
CHEM	375	Chemical Oceanography	3
CHEM	377	Environmental Chemistry	3
GEOG	432	Biogeography	3

The instructional staff for the courses listed above consists of the following:

MARINE SCIENCES

Biology

Bane, Gilbert W., Ph.D., Director of Marine Sciences and Professor of Biology
Brauer, Ralph W., Ph.D., Director of IMBR, Professor of Marine Physiology
Dermid, J.D., M.S., Associate Professor of Biology
George, Robert Y., Ph.D., Professor of Biology
Hosier, Paul E., Ph.D., Associate Professor of Biology
Kapraun, Donald F., Ph.D., Associate Professor of Biology
Lindquist, David G., Ph.D., Assistant Professor of Biology
McCrary, Anne B., Ph.D., Associate Professor of Biology
Padgett, David E., Ph.D., Assistant Professor of Biology
Parnell, James F., Ph.D., Professor of Biology
Roye, David B., Ph.D., Associate Professor of Biology

Chemistry

Adcock, Louis H., Ph.D., Professor of Chemistry
Willey, Joan D., Ph.D., Assistant Professor of Chemistry

Earth Sciences

Cleary, William J., Ph.D., Associate Professor of Geology
Harris, William B., Ph.D., Assistant Professor of Geology
Thayer, Paul A., Ph.D., Professor of Geology
Zullo, Victor A., Ph.D., Professor of Geology

Physical Education

Chapman, Frank L., Lecturer in Physical Education

To obtain additional information, address all inquiries to:

Dr. Gilbert W. Bane, Director
Program in Marine Sciences
University of North Carolina at Wilmington
Wilmington, North Carolina 28403

UNIVERSITY OF NORTH DAKOTA
Grand Forks, North Dakota 58202

The fisheries program at the University of North Dakota does research in various freshwater bodies of water in North Dakota including Garrison Reservoir and Lake Ashtabula. A fisheries laboratory is presently under construction on campus. The department has access to a recording depth finder, limnology equipment, capture gear, electrical resistance thermometers and several small fishing boats.

The University of North Dakota offers a B.S. degree in Fishery and Wildlife Management. The fisheries option of this degree places emphasis on fresh-water sport fishery management. It requires 51-54 semester hours in biology and courses in geology, chemistry and mathematics. They also offer the M.S. and Ph.D. in Biology with fisheries or limnology options.

DEPARTMENT OF BIOLOGY

Undergraduate

The Department of Biology offers concentrated study in four areas: Biology, Botany, Zoology and Fishery and Wildlife Management. Thirty-six hours are required for the major and 20 hours for the minor. The objective of these majors is to provide students with a broad knowledge of modern biology through training in each of the major areas of biological science: ecologic, genetic, molecular, morphologic and systematic biology.

In addition to the classrooms and specialized teaching laboratories, the Biology building houses an herbarioum, an animal room, a greenhouse, a controlled environment laboratory, a darkroom and graduate student research laboratories. Facilities for aquatic biology, including offices and teaching and research laboratories, are maintained in Montgomery Hall. Facilities for entomology and behavior are located in Old Science Hall. SA laboratory for pheromone analysis and bioassay is maintained in Chandler Hall. The Department also maintains three natural areas for use in teaching and research as well as the University Biological Station at Devils Lake.

Well qualified majors are urged to participate in independent studies, honors work, or undergraduate research. Normally, studies of this nature are initiated by invitation from a faculty member. Students selected for these programs usually carry out their studies in the research laboratories of the individual professors. Research assistantships financed by faculty research grants may be available for part-time employment. The department participates in the University Honors Program through certain interdisciplinary colloquia, by honors credit in advanced courses, and by independent studies and tutorials in advanced topics.

The following undergraduate degrees are offered:

1. B.S. with major in Biology
2. B.S. with a major in Botany
3. B.S. in Fishery and Wildlife Management
4. B.S. with a major in Zoology
5. B.S.ED. with a major in Biological and Physical Sciences

The following courses are offered:

101, 102	Introduction to Biology	8
235	Human Environment	2
312	Evolution	2
332	General Ecology	4
336	Systematic Botany	4
338	Animal Behavior	4
341	Cell Physiology	4
343	Plant Physiology	3
350	Genetics	3
351	Genetics Laboratory	1
357	Modern Genetics and Man	3
360	Freshwater Algae	4
362	Plant Morphology	4
363	Entomology	4
364	Parasitology	4
367	Cytology	3
368	Cytological Techniques	1
369	Histology	3
370	Vertebrate Zoology	2
371	Anatomy and Adaptations Laboratory	2
373	Vertebrate Natural History	3
374	Vertebrate Embryology	4
375	Invertebrate Zoology	4
403	Seminar	1
411	Taxonomy of Lower Plants	3
425	Ichthyology	3
427	Ornithology	3
428	Mammalogy	3
431	Wildlife Management	4
433	Limnology	4
438	Game Fish Management	3
442	Physiology of Organs and Systems	4
460	Plant Anatomy	3
470	Biometry	3
471, 472	Basic Principles of Biology	8
475	History and Philosophy of Biology	2
477	Concepts of Biology	2
491	Directed Studies	1-4
498	Research	1-4
499	Senior Honors	2-15

DEPARTMENT OF BOTANY

(See Biology for courses.)

DEPARTMENT OF BIOLOGY

Graduate School

The Department of Biology offers graduate studies leading to the Master of Science, Master of Education, Doctor of Arts and Doctor of Philosophy degrees. These programs are designed to prepare students for academic teaching and research, research in government service, and research and developmental opportunities in industry. The department offers graduate work in the following areas: Ecology, including Behavior; Genetics; Morphology; Physiology, and Systematics. Traditionally, departmental emphasis has been in ecological areas.

Facilities for Graduate Research: Biology faculty and graduate students occupy all or portions of six buildings. The Biology Building houses a herbarium containing about 30,000 specimens, an animal room, darkroom, greenhouse, vertebrate research museum and a controlled environment room with growth chambers. Laboratories for limnology and fisheries biology are located in Montgomery Hall. In the Science Building are found an insect museum, biometry laboratory, and facilities for animal behavior research. Chandler Hall contains the Institute for Ecological Studies and facilities for pheromone research, the fisheries laboratories and the Project Reclamation Research. Protozoology research facilities are in Larimore Hall and the plant tissue culture and genetics research unit is located in Budge Hall.

The Biology Department is strongly oriented toward studies in field biology, and the Department operates three field stations for research and class use. The Devils Lake Station is located 90 miles west of Grand Forks and is suited for aquatic research. The Forest River Biology Area is 40 miles from the campus. It includes habitats suitable for studies in aquatic and woodland biology; spring brook, swamp, moist and dry woods and a section of the Forest River. The Oakville Prairie Station consists of 800 acres of virgin upland and lowland prairies and is located 12 miles from the campus. Both of these areas have laboratory and housing facilities and, in addition, Oakville Prairie has facilities for year-round bioclimatological studies. A fourth area consists of 600 acres of old fields located 17 miles from the campus. This tract is used for studies of secondary succession and wildlife management.

The North Dakota Fishery Research Unit, a cooperative operation of the Biology Department and the North Dakota Game and Fish Department, conducts research needed for and directed to the management of sport and commercial fisheries and the protection of aquatic environments in the State. The Department participates in the planning for the University of Minnesota Forestry and Biological Station at Itasca through representation on the Itasca Advisory Council.

Departmental Degree Requirements: Master of Science. The requirements are a 20-credit major (including research and thesis) and a 10-credit minor. The minor may be taken within the Department or from one of the other biological or physical science departments in the University. Other requirements include two credits of seminar and satisfactory completion of a comprehensive examination by the student's advisory committee.

Doctor of Arts. This degree program is designed to produce broadly trained biology teachers for the four-year and junior colleges. A dissertation is not required, but students must have some research and technical writing experience as part of their program. Only those persons holding a master's degree are eligible for admission to the program. A teaching internship is required as part of this program.

Doctor of Philosophy. The most important feature of the Ph.D. program is the performance of an independent piece of research and the writing of a dissertation which is an original contribution to knowledge suitable for publication. Other requirements include six credits of seminar, reading knowledge of a foreign language, and attendnace for one session at an approved field station, preferably marine or tropical. A minor is not required but each student is expected to show competence in related areas as determined by the student's advisory committee. Work completed on a master's degree program may be incorporated into the doctoral program if approved by the student's advisory committee.

The following courses are offered in conjunction with the above programs:

500	Biological Literature and Scientific Writing	2

501	Biology of North Dakota	2-4
502	Field Biology	2-3
503	Seminar	1
504	College Biology Teaching	3
510	Principles of Taxonomy	2
511	Cytotaxonomy	2
512	Palynology	2
514	Algal Physiology	3
515	Algal Ecology	3
517	Aquatic Plants	2
519	Aquatic Invertebrates	3
520	Helminthology	3
522	Medically Important Arthropods	2
530	Biogeography	3
532	Forest Ecology	2
533	Grassland Ecology	2
535	Physiological Ecology	3
537	Animal Population Ecology	2
538	Animal Communication	3
539	Animal Societies	2
544	Advanced Topics in Physiology	2
551	Biochemical Genetics	3
554	Cytogenetics	2
557	Population Genetics	3
564	Developmental Morphology of Plants	2
571	Sampling Theory	4
575	Advanced Fishery Biology	3
576	Museum Techniques	1
578	Wildlife Disease	3
587	Teaching Internship in Biology	1-12
592	Directed Studies	Arranged
599	Research	Arranged

312	Evolution	2
332	General Ecology	4
336	Systematic Botany	4
338	Ethology	3
341	Cell Physiology	4
343	Plant Physiology	4
350	Genetics	3
351	Genetics Laboratory	1
362	Plant Morphology	4
363	Entomology	4
364	Parasitology	4
367	Cytology	3
368	Cytological Techniques	1
369	Histology	3
370	Vertebrate Zoology	2
371	Anatomy and Adaptations Laboratory	2
373	Natural History Laboratory	2
374	Vertebrate Embryology	4
375	Invertebrate Zoology	4
380	Phycology (pending approval by Graduate Committee)	4
411	Taxonomy of Lower Plants	3
425	Ichthyology	3
427	Ornithology	3
428	Mammalogy	3
431	Wildlife Management	4
433	Limnology	4
438	Game Fish Management	3
442	Physiology of Organs and Systems	4
460	Plant Anatomy	3
470	Biometry	3
471	Basic Principles of Biology	4
472	Basic Principles of Biology	4
475	History and Philosophy of Biology	2

The instructional staff for the courses listed above consists of the following:

Crawford, Richard D., Ph.D., Assistant Professor of Biology

Facey, Vera L., Ph.D., Professor of Biology and Curator of the Herbarium.

Fitch, John H., Ph.D., Assistant Professor of Biology

Fivizzani, Albert J., Jr., Ph.D., Assistant Professor of Biology

Holloway, Harry L., Jr., Ph.D., Professor of Biology

Jalal, Syed M., Ph.D., Professor of Biology

Kannowski, Paul B., Ph.D., Professor of Biology

Larson, Omer R., Ph.D., Professor and Chairman of Biology

Neel, Joe K., Ph.D., Professor of Biology

Oring, Lewis W., Ph.D., Professor of Biology

Owen, Alice K., Ph.D., Assistant Professor of Biology and Physiology (part time)

Owen, John B., Ph.D., Professor of Biology and Leader of the North Dakota Fishery Research Unit

Seabloom, Robert W., Ph.D., Professor of Biology

Sheridan, William F., Ph.D., Associate Professor of Biology

Shubert, L. Elliot, Ph.D., Associate Professor of Biology

Wali, Mohan K., Ph.D., Associate Professor of Biology

Wrenn, William J., Ph.D., Associate Professor of Biology

To obtain further information, address inquiries to:

Omer R. Larson, Chairman
Department of Biology
University of North Dakota
Grand Forks, North Dakota 58202

UNIVERSITY OF OREGON

Eugene, Oregon 97403

The University offers marine biology courses at both the main campus in Eugene and at Oregon Institue of Marine Biology, Charleston, Oregon. Modern science buildings in Eugene include laboratory facilities for departments of biology, chemistry, molecular biology and physics.

Oregon Institute of Marine Biology is located on about 85 acres along Coos Bay. The Institute buildings include dormitories, dining hall, classrooms and laboratories. There are six laboratory classrooms with running salt water, study tables and benches. One renovated building, used for year-round research, houses modern equipment such as a refrigerated centrifuge, spectrophotometers, and scintillation systems, Zeiss microscope equipped with Nomarski optics.

No degrees are offered by the Institute; however, the University of Oregon awards credit, including graduate credit for all courses designated (G) or at the 500 level. Work done at the Institute may form an integral part of the work towards Bachelor's, Master's, or Ph.D. degrees in Biology offered on the Eugene campus.

Courses in the marine sciences are offered during the regular year at the main campus by the Department of Biology. The Department of Biology also offers both regular summer and special workshop courses at the Institute. Independent studies and research have been carried out on a year-round basis at the Institute since 1968. A fall term program in biology includes Marine Ecology, Invertebrate Zoology, Estuarine Ecology and research credit. During the spring, a multi-disciplined approach to man and his environmental problems will be offered entitled "People and the Oregon Coast." This program will include courses in biology, sociology, geography, landscape architecture and political science.

The following courses are offered at the Institute. All courses can be taken for undergraduate credit. Those marked with a (G) or at the 500 level will satisfy graduate requirements.

Bio 406	Field Studies (G)	
Bio 413	Comparative Physiology (G)	8
Bio 458	Marine Birds and Mammals (G)	4
Bio 461	Invertebrate Zoology (G)	8
Bio 474	The Marine Environment (G)	8
Bio 477	Estuarine Biology (G)	
Bio 478	Marine Ecology (G)	8
Bio 401	Research	
Bio 501	Research (G)	
Bio 403	Thesis (G)	
Bio 503	Thesis (G)	
Bio 407	Seminar - Topics in Marine Biology	
Bio 507	Seminar - Topics in Marine Biology (G)	
Bio 360	Coastal Biology	
Bio 408	Laboratory Projects (G)	
Bio 408	Biological Illustration	
Bio 410	Behavioral Ecology of Fishes (G)	

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Frank, Peter, Professor of Biology

McConnaughey, Bayard H., Ph.D., Professor of Biology

McGowan, John A., Ph.D., Visiting Professor of Oceanography

Rudy, Paul P., Ph.D., Professor of Biology, University of Oregon, Director, Oregon Institute of Marine Biology

Terwilliger, Robert C., Ph.D., Professor of Biology, University of Oregon, Assistant Director, Oregon Institute of Marine Biology

To obtain further information, address inquiries to:

Dr. Paul P. Rudy, Director
Oregon Institute of Marine Biology
Charleston, Oregon 97420
(503) 888-5534

UNIVERSITY OF OREGON SCHOOL OF LAW
Eugene, Oregon 97403

The Law School offers courses at the legal center building on the campus in Eugene. An Ocean Law Library and the facilities of the Law School library are used for research. In conjunction with the marine advisory program, the Law School conducts seminars at the law center and at various coastal locations, attended by members of Oregon ocean industries, Oregon State University oceanographers, other scientists, Oregon Law School faculty members and interested members of the bar and government.

The Oregon Law School ocean law program is part of the Oregon State University Sea Grant College. The J.D. degree is offered.

The following courses are offered in conjunction with the above program:

Ocean Resources Law	3
International Law	3
Natural Resources Law	3
Environmental Quality	3
Water Law	3
Admiralty Law	3

The instructional staff for the courses listed above consists of the following:

Barry, Frank J., LL.B., Professor
Clark, Chapin D., LL.M., Professor
Jacobson, Jon L., J.D., Associate Professor
Swan, Peter N., LL.B., Associate Professor

To obtain further information, address inquiries to:

Professor Jon L. Jacobson
University of Oregon School of Law
Eugene, Oregon 97403

UNIVERSITY OF THE PACIFIC
PACIFIC MARINE STATION
Dillon Beach, California 94929

The marine station lies 60 miles north of San Francisco on the southern shore of Bodega Bay adjacent to Tomales Bay and just opposite the Point Reyes National Seashore. The high diversity of marine environments close by renders the area very suitable as a laboratory site. Sand beaches, intertidal sand flats, rocky shores, salt marsh, and kelp beds are within easy access. The local flora and fauna are correspondingly rich.

The station consists of three research and office buildings and several auxiliary structures; the former house teaching, research and instrument laboratories, photographic darkroom, museum, stockroom, and library. All laboratories are supplied with fresh seawater pumped directly from the ocean to two large holding tanks. The station maintains two research vessels: a 17-foot Boston Whaler and a new 42-foot steel-hull vessel designed for offshore research.

GRADUATE PROGRAM

The Pacific Marine Station, a division of the University of the Pacific, is a year-round research center with a graduate program leading to a Master of Science degree.

Twelve years ago, the marine station began a program of research, stressing ecology and systematics in the broadest sense. The principal theme of the ecology program is to determine the factors responsible for the seasonal and long-term changes in marine ecosystems. Current studies range from analyzing the effects of a variety of physical stresses on sand flat communities to evaluating the role of predation in determining gastropod distribution on rocky shores. This program supplies the information necessary to develop sound impact studies and to evaluate the disturbances caused by man. The ecology program provides both background data and a broader context for other scientific programs.

Studies on the functional morphology of marine organisms are aimed at a better understanding of the interrelationships between organ systems and environmental conditions. These studies are currently focused on more complete knowledge of feeding and nutritional biology in marine invertebrates, larvae, and the ecological implications of larval biology.

Graduate students are encouraged to participate in the research programs underway at the station. Research assistants work 50 percent of their time on the various projects. From their contact with staff members and the multitude of research problems that come to their attention during their involvement in the various ecology research programs, students have little difficulty in finding thesis problems.

UNDERGRADUATE PROGRAM

The undergraduate program in marine science is designed for students of biology with upperclass standing. The 16 semester units are partitioned between two of the formal four-unit courses offered and eight units of research, normally on a specific problem related to one of the current research programs at the pacific marine station. There are three main objectives of this program.

First, it affords undergraduates the opportunity of having a marine experience, of studying marine biology and ecology at the source.

Secondly, the program provides an opportunity to carry on original research either within the context of one of the current faculty research programs or in some other area.

Finally, it is hoped that the scientific experience gained during this semester will enable an individual to give throughtful consideration to all of the parameters of complex environmental problems.

Upon completion of the program it is expected that a student will be able to: understand some of the complex relationships between species of animals, substrata, food chains, larval development and morphological adaptations; evaluate the scientific basis for statements in newspapers and magazines on conservation and the development of the natural resources; design a limited research program, and know how to apply scientific results to the solution of environmental problems.

Undergraduate students with advanced standing in biology will take two courses selected from those offered and spend the other two courses in participation in one of the station's on-going research projects. Departures from this scheme, including initiation of new projects, is possible by special arrangement.

Course credit will fit into the undergraduate program through the University of the Pacific. Application deadlines are April 1 and November 1.

The following courses are offered each year:

Fall Semester

Biometrics
Invertebrate Zoology
General Oceanography
Advanced Invertebrate Zoology
Evolution Seminar

Spring Semester

Ecology
Invertebrate Zoology
Physiology of Marine Animals
Invertebrate Embryology
Evolution Seminar

Summer Courses

Ichthyology
Phycology

In addition, two units special topics courses may be offered on demand in such subject areas as: systematics, photographic techniques, computer programming, and scientific illustration.

Instructional staff for the courses listed above consists of the following:

Armitage, Eric, J.D., Business Manager, Research Associate
James A. Blake, Ph.D., Assistant Director, Assistant Professor of Zoology. Development of marine invertebrates, taxonomy of polychaeta.
Kaill, William M.,Ph.D., Assistant Professor of Biology. Coordinator-undergraduate program.
Loosanoff, Victor L., Ph.D., Adjunct Professor of Marine Biology, mariculture.
Obrebski, Steven, Ph.D., Assistant Professor of Ecology, Ecology and evolution of marine invertebrates; computer simulation models
Smith, Edmund H., Ph.D., Director, Professor of Zoology, functional morphology of mollusca.

To obtain further information, address inquiries to:

Director
University of the Pacific
Pacific Marine Station
Dillon Beach, California 94929

UNIVERSITY OF RHODE ISLAND
Kingston, Rhode Island 02881

Marine-related education is an important function in several of the University's colleges. The most important fields are: Oceanography, Ocean Engineering, Marine Affairs, Fisheries and Marine Technology, Marine Resource Economics. In addition, there are faculty members with strong marine interests in other science and social science departments. The University is a Sea Grant College, and it operates several marine public service programs.

Marine-related education, research, and public service programs operate under the cognizance of the Provost for Marine Affairs, Dr. John A. Knauss. For information on specific programs, write the individuals listed below.

GRADUATE SCHOOL OF OCEANOGRAPHY

The Graduate School of Oceanography maintains a group of laboratories, offices and support facilities at the Narragansett Bay Campus, a waterfront location in Narragansett, Rhode Island. Principal structures are the Charles J. Fish Oceanographic Laboratory, the Francis H. Horn Laboratory, the Norman Watkins Marine Science Building, and the Claiborne Pell Marine Science Library. The graduate school operates the R/V Endeavor, a 177-foot research vessel, and a number of small craft.

The University offers the degrees of Master of Science in Oceanography and Doctor of Philosophy in Oceanography. Both degrees are given with options in biological, chemical, geological and physical oceanography.

The following courses in Oceanography (OCG) are offered:

401	General Oceanography	3
491	Ocean Studies	15
492	Ocean Studies	
501	Physical Oceanography	3
509	Ecological Aspects of Marine Pollution	3
510	Descriptive Physical Oceanography	3
521	Chemical Oceanography	3
524	Chemistry of Marine Atmosphere	3
540	Geological Oceanography	3
544	Seminar in Petrogenesis	3
545	Geomagnetism and Paleomagnetism	3
547	Seminar in Biomagnetism	2
561	Biological Oceanography	3
568	Fishery Biology	3
571	Benthic Environment	3
574	Biology of Marine Mammals	3
576	Heterotrophic Microbiology of the Sea	3
577	Marine Epimicrobiology	3
599	Masters Thesis Research	1-6
605	Dynamical Oceanography	3
607	Geophysical Models	3
609	Dynamics of Mixing	3
610	Geophysical Fluid Dynamics	3
611	Geophysical Fluid Dynamics	3
612	Seminar in Marine Pollution	2
613	Waves	3
614	Tides	2
620	Chemical Distributions	3
621	Estuary and Coastal Zone	3
623	Physical Chemistry of Seawater	3
625	Organic Geochemistry	3
630	Geochemistry	3
631	Seminar in Marine Chemistry	1
641	Geology of Continental Margins I	3
642	Geology of Continental Margins II	3
643	Seminar in Deep Sea Geology	3
644	Thermodynamics of Earth's Interior	3
645	Petrology of Oceanic Crust	3
646	Deep Sea Sediments and Processes	3
647	Recent Sedimentary Environments I	3
648	Recent Sedimentary Environments II	3
649	Marine Paleo-Ecology	3
650	Micropaleontology of Radiolaria	3
651	Cenozoic Marine Stratigraphy	2
660	Ecological Concepts in Marine Research	3
661	Phytoplankton Taxonomy	3
663	Phytoplankton Physiology	3
664	Phytoplankton Ecology	3
666	Zooplankton	3
667	Advanced Phytoplankton Seminar	2
668	Advanced Phytoplankton Seminar	2
669	Advanced Phytoplankton Seminar	2
672	Marine Invertebrates and Environment	3
679	Animal Communication	2
691	Individual Study	1-6
692	Individual Study	1-6
693	Special Studies	1-4
694	Special Studies	1-4
695	Seminar in Oceanography	1
699	Ph.D. Dissertation Research	1-12

The instructional staff for the courses listed above consists of the following:

Bender, Michael L., Ph.D., Associate Professor
Butman, Bradford, Ph.D., Adjunct Professor
deBoer, Jelle, Ph.D., Adjunct Professor
Detrick, Robert, Jr., Ph.D., Assistant Professor
Duce, Robert A., Ph.D., Professor
Eisler, Ronald, Ph.D., Adjunct Professor
Elmgren, Ragnar, Ph.D., Adjunct Professor
Evans, David, Ph.D., Assistant Professor
Hargraves, Paul E., Ph.D., Associate Professor
Heath, G. Ross, Ph.D., Adjunct Professor
Imbrie, John, Ph.D., Adjunct Professor
Jeffries, H. Perry, Ph.D., Professor
Kennett, James P., Ph.D., Professor
Kester, Dana R., Ph.D., Professor
Knauss, John A., Ph.D., Professor, Dean and Provost for Marine Affairs
Laine, Edward, Ph.D., Lecturer
Lambert, Richard, Ph.D., Adjunct Professor
Marshall, Nelson, Ph.D., Professor
McMaster, Robert L., Ph.D., Professor
Moore, Theodore C., Jr., Ph.D., Professor
Napora, Theodore A., Ph.D., Associate Professor and Assistant Dean for Students
Nixon, Scott W., Ph.D., Associate Professor
Oviatt, Candace, Ph.D., Lecturer
Phelps, Donald, Ph.D., Adjunct Professor
Pilson, Michael E.Q., Ph.D., Professor
Quinn, James G., Ph.D., Professor
Rossby, Hans Thomas, Ph.D., Professor
Saila, Saul B., Ph.D., Professor
Sastry, Akella N., Ph.D., Professor
Schilling, Jean-Guy, Ph.D., Professor
Schneider, Eric, Ph.D., Adjunct Professor
Sherman, Kenneth, Ph.D., Adjunct Professor
Shonting, David, Ph.D., Adjunct Professor
Sieburth, John McN., Ph.D., Professor
Sigurdsson, Haraldur, Ph.D., Associate Professor
Smayda, Theodore J., Ph.D., Professor
Stern, Melvin E., Ph.D., Professor

Swift, Elijah V., Ph.D., Associate Professor
Tenore, Kenneth, Ph.D., Adjunct Professor
Watts, D. Randolph, Ph.D., Assistant Professor
Weisberg, Robert, Ph.D., Adjunct Professor
Wimbush, Mark, Ph.D., Associate Professor
Winn, Howard E., Ph.D., Professor

During the academic year 1977-1978, 12 M.S. and 21 Ph.D. degrees were awarded.

For further information, address inquiries to:

Dr. John A. Knauss, Dean
Graduate School of Oceanography
Narragansett Bay Campus
University of Rhode Island
Narragansett, Rhode Island 02882

DEPARTMENT OF OCEAN ENGINEERING

The Department of Ocean Engineering operates two motor boats which are used for research in Narragansett Bay. The shore facilities and ship facilities of the Graduate School of Oceanography are available to ocean engineering faculty and graduate students. In addition, the College of Engineering laboratories include a well-equipped solids and sediments laboratory, an underwater acoustics laboratory in a new building, a sub-critical reactor, wave and model tanks in the several engineering buildings. Nearby Navy and industrial laboratories have made many of their facilities available for cooperative research work.

The Department offers the Ph.D. and M.S. in Ocean Engineering.

The following courses are offered in conjunction with the above program:

OCE 346	Skin and Scuba Diving, Beginners
OCE 347	Skin and Scuba Diving, Advanced
OCE 401	Introduction to Ocean Engineering Systems I
OCE 402	Introduction to Ocean Engineering Systems II
OCE 403	Introduction to Ocean Engineering Processes I
OCE 404	Introduction to Ocean Engineering Processes II
OCE 410	Basic Ocean Measurements
OCE 457	Fluidics
OCE 500	Basic Ocean Engineering
OCE 512	Hydrodynamics of Floating and Submerged Bodies I
OCE 513	Hydrodynamics of Floating and Submerged Bodies II
OCE 521	Materials Technology in Ocean Engineering
OCE 531	Underwater Power Systems
OCE 532	Coastal Zone Power Plants
OCE 534	Corrosion and Corrosion Control
OCE 535	Advanced Course in Corrosion
OCE 540	Environmental Control in Ocean Engineering
OCE 560	Introduction to Data Collection Systems
OCE 561	Introduction to the Analysis of Oceanographic Data
OCE 565	Ocean Laboratory I
OCE 571	Underwater Acoustics I
OCE 587	Submarine Soil Mechanics
OCE 591	Special Problems
OCE 599	Masters Thesis Research
OCE 605	Ocean Engineering Seminar
OCE 610	Engineering Ocean Mechanics
OCE 611X	Coastal Zone Processes
OCE 612X	Numerical Modeling of Coastal Processes
OCE 653	Ocean Engineering System Studies I
OCE 654	Ocean Engineering System Studies II
OCE 661	Analysis of Oceanographic Data
OCE 672	Underwater Acoustics II
OCE 673	Advanced Course in Underwater Acoustic Propagation
OCE 674	Nonlinear Acoustics
OCE 675	Processing of Underwater Acoustic Data
OCE 676	Acoustic Radiation from Underwater Vibrators
OCE 691	Special Problems
OCE 699	Doctoral Dissertation Research

The instructional staff for the courses listed above consists of the following:

DiNapoli, F., Ph.D., Adjunct Associate Professor
Haas, R.S., M.S., Professor
Heidersbach, R.H., Ph.D., Associate Professor
Kowalski, T., Ph.D., Professor
LeBlanc, L.R., Ph.D., Associate Professor
Middleton, F.H., Dr. Eng., Professor
Moffett, M.B., Ph.D., Adjunct Associate Professor
Nacci, V.A., M.S., Professor
Rose, V.C., Ph.D., Associate Professor
Schenck, H., M.S., Professor
Sheets, H.E., Sc.D., Professor
Sherman, C., Ph.D., Adjunct Associate Professor
Spaulding, M.L., Ph.D., Associate Professor
Stepanishen, P.R., Ph.D., Associate Professor
White, F.M., Ph.D., Professor

To obtain further information, address inquiries to:

Chairman
Department of Ocean Engineering
201 Lippitt Hall
University of Rhode Island
Kingston, Rhode Island 02881

Chemical and Ocean Engineering: Students enrolled in this curriculum will follow the program of study for chemical engineering during the freshman, sophomore, and junior years. The concentration requires 131 credits.

Senior year; first semester, 16 credits

CHE 349	Transfer Operations III	2
CHE 351	Plant Design and Economics*	2
CHE 403	Introduction to Ocean Engineering Processes I	3
CHE 464	Industrial Reaction Kinetics	3
OCG 401	General Oceanography	3
General Education Elective		3

Senior year; second semester, 18 credits

CHE 352	Plant Design and Economics*	3
CHE 404	Introduction to Ocean Engineering Processes II	3
CHE 534	Corrosion and Corrosion Control	3
OCE 410	Basic Ocean Measurements	3
General Education Electives		6

*These will include applications to Ocean Engineering problems for students selecting the Chemical and Ocean Engineering option.

To obtain further information, address inquiries to:

Dr. Harold N. Knickle
Department of Chemical Engineering
University of Rhode Island
Kingston, Rhode Island 02881

Mechanical and Ocean Engineering: Students enrolled in this curriculum will follow the program of study for mechanical engineering and applied mechanics during the freshman, sophomore and junior years. This curriculum requires 129-130 credits. The senior year for the classes of 1979, 1980, and 1981 is shown below.

Senior year; first semester, 18 credits

MCE 401	Introduction to Ocean Engineering Systems I	3
MCE 423	Design to Machine Elements	3
OCG 401	General Oceanography	3
PHY 425	Acoustics	3
Ocean related electives*		6

Senior year; second semester, 15 credits

MCE 402	Introduction to Ocean Engineering Systems II	3
OCE 410	Basic Ocean Measurements	3
General Education Elective		3
Ocean-related engineering or science elective*		3
Free elective		3

*The ocean-related electives are chosen by the student in consultation with the advisor.

To obtain further information, address inquiries to:

Dr. Charles D. Nash, Jr.
Department of Mechanical Engineering
University of Rhode Island
Kingston, Rhode Island 02881

GEOGRAPHY AND MARINE AFFAIRS

Marine Environmental Policy Option: This option has been developed in answer to the heightened interest in coastal and ocean management issues and the need for entry-level manpower with undergraduate training. Students selecting this option must complete a minimum of 29 credits including nine credits selected from:

GEG 100	The Geography of Human Ecosystems	3
GEG 102	Geography of Social Issues	3
GEG 103	Economic Geography	3
GEG 131	Political Geography	3

and all of the following:

GEG 482	Quantitative Methods in Geography	3
OCG 401	General Oceanography	3
ESC 104	Geographical Earth Science	4
ESC 105	Geological Earth Science	4
ESC 106	Introductory Geology Laboratory	1
MAF 210	Human Use and Control of the Marine Environment	3
MAF 410	Problems in Marine Affairs	3

Courses may also be taken from the following list:

GEG 452	Transportation Geography	3
GEG 461	Coastal Zone Uses	3
GEG 471	Island Systems	3
GEG 472	Marine Recreation	3
GEG 571	Marine Geography	3
GEG 572	Geography of Ocean Regions	3

To obtain further information, address inquiries to:

Dr. Lawrence Juda
Department of Geography and Marine Affairs
University of Rhode Island
Kingston, Rhode Island 02881

DEPARTMENT OF FISHERIES AND MARINE TECHNOLOGY

The Department of Fisheries and Marine Technology, located in the College of Resource Development, maintains a mini-campus on the waterfront in Wickford, Rhode Island, where training vessels are berthed. Facilities contain classrooms and practical teaching laboratories for seamanship, fishing gear, navigation, marine electricity and electronics, electronic aids, diesel and hydraulics technology. The 47-foot vessel, Gail Ann, is fully equipped with electronic aids including Loran C and sonar, being outfitted to provide training in all important commercial fishing techniques.

A two-year Associate Degree Program (Associate in Science) is directed primarily toward preparation for the commercial fishing industry; an option aimed toward more general marine technology is available. All students are required to complete 72 credits over a two-year period -- 51 in professional commercial fisheries and 21 in general education and background subject matter.

A four-year Bachelor Degree Program (B.S. in Resource Development) is administered within the B.S. curricula of the College of Resource Development. Within the total requirement of 130 credit hours, students may shape a program of studies to meet individual needs, professional objectives, and career goals by appropriate selection among requirements for a basic core, major area of concentration, directed electives, and free electives.

A Graduate Certificate Program in Commercial Fisheries is to be taken in conjunction with the Master of Marine Affairs Degree. Fifteen credits beyond the 30 needed for the MMA are required, together with specified course selections for nine credits of MMA program electives. Six credits of special problems in Fisheries and Marine Technology are mandatory. Students without previous in-depth background in applied commercial fisheries are required to fulfill preparatory study arranged to suit individual needs.

The following courses are offered in conjunction with the above programs:

FMT 013	Shipboard Work I	2
FMT 014	Shipboard Work II	1
FMT 101	Shipboard Safety	3
FMT 110	Marine Technology	4

FMT 113	Vessel Operations	1
FMT 118	Introduction to Commercial Fisheries	3
FMT 121	Fishing Gear I	3
FMT 131	Seamanship	3
FMT 222	Fishing Gear II	3
FMT 235	Fisheries Meteorology	2
FMT 241	Diesel Engineering Technology	4
FMT 242	Fluid Power Technology	4
FMT 261	Marine Electronics	3
FMT 281	Navigation I	4
FMT 293	Fishing Operations Practicum	1
FMT 351	Fish Preservation	3
FMT 371	Ship Technology	4
FMT 382	Navigation II	4
FMT 391	Special Problems	3
FMT 392	Special Problems	3
FMT 393	Fishing Operations	3
FMT 416	Marine Transportation	3
FMT 452	Industrial Fishery Technology	3
FMT 518	Marine Fisheries Technology	3
FMT 522	Fishing Gear Technology	3
FMT 591	Special Problems	3
FMT 592	Special Problems	3

The instructional staff for the courses listed above consists of the following:

Gamache, George E., B.S., Instructor
Hillier, Albert J., Assistant Professor
Merriam, Robert W., S.M., Associate Professor
Motte, Geoffrey A., Ph.D., Associate Professor
Raush, Richard R., Ph.D., Assistant Professor
Sainsbury, John C., Ph.D., Professor
Stout, Thomas M., M.S., Assistant Professor
Wing, Richard A., M.Ed., Assistant Professor

The following degrees were granted during the academic year 1978-1979: Thirty Associate in Science and 14 Bachelor of Science.

To obtain further information, address inquiries to:

Dr. G.A. Motte, Chairman
Department of Fisheries and Marine Technology
University of Rhode Island
Kingston, Rhode Island 02881

Master of Marine Affairs (MMA) and Master of Arts in Marine Affairs (MAMA) Programs

The University also offers the Degree of Master of Marine Affairs. The program is administratively within the Department of Geography and Marine Affairs and is supervised by an administering committee composed of the Provost for Marine Affairs, Dean of the Graduate School of Oceanography, the Chairman or his representative of the Departments of Ocean Engineering, Resource Economics, Geography, Geology, and Political Science. Admission to the MMA Program normally requires a graduate degree and experience in marine-related employment. The course of study is designed for persons interested in management and policy problems associated with marine activities.

The MMA Program is interdisciplinary. There is a one-academic-year, non-thesis graduate curriculum for students with second degrees or experience in marine-related fields, and a two-academic-year thesis-required curriculum to other students.

Additional coursework and/or supervised research in areas of the student's basic expertise is done among the graduate courses offered at the University in oceanography, ocean engineering, political science, geography, and business administration. Integration of the coursework for a meaningful appreciation of elements of management and decision making in high seas and coastal zone marine resources is conducted in the Marine Affairs Seminar. Furthermore, students who wish to concentrate in Fisheries Management can take an additional 15 credits in Fisheries courses and receive an MMA with Certificate in Commercial Fisheries.

The following courses in the marine sciences are offered in conjunction with these programs. In addition, graduate students in oceanography may choose from supporting courses in other departments of the University:

Core Courses

GEG 571	Marine Geography	3
REN 514	Economics of Marine Resources	3
OGG 401	General Oceanography	3
PSC 464	International Law	3
MAF 651	Marine Affairs Seminar	3
MAF 652	Marine Affairs Seminar	3

Additional Courses

MAF 210	Human Use and Control of the Marine Environment	3
MAF 521	Coastal Zone Law	3
MAF 523	Fisheries Law and Management	3
MAF 312	The Politics of the Ocean	3
MAF 410	Problems in Marine Affairs	3
MAF 483	International Ocean Law	3
MAF 562	Admiralty Law	3
MAF 564	Port Geography and Policy	3
MAF 578	International Ocean Organizations	3
MAF 586	Environmental Impact Assessment and Analysis	3

The instructional staff for the courses listed above consists of the following:

GRADUATE SCHOOL OF OCEANOGRAPHY

Knauss, John A., Ph.D., Provost for Marine Affairs and Dean
Marshall, Nelson, Ph.D., Professor of Oceanography

DEPARTMENT OF OCEAN ENGINEERING

Kowalski, T., Ph.D., Professor of Ocean Engineering

DEPARTMENT OF GEOGRAPHY AND MARINE AFFAIRS

Alexander, Lewis M., Ph.D., Chairman and Professor of Geography and Marine Affairs
Cameron, Francis, J.D., Associate Professor
Juda, Lawrence, Ph.D., Assistant Professor
Nixon, Dennis, J.D., Assistant Professor
West, Niels, Ph.D., Associate Professor

DEPARTMENT OF RESOURCE ECONOMICS

Rorholm, Niels, Ph.D., Professor of Resource Economics

DEPARTMENT OF GEOLOGY

Fisher, John J., Ph.D., Assistant Professor of Geology

To obtain further information, address inquiries to:

Dr. Lewis M. Alexander, Director
Marine Affairs Program
320 Washburn Hall
University of Rhode Island
Kingston, Rhode Island 02881

DEPARTMENT OF RESOURCE ECONOMICS

The Department has an undergraduate (B.S.) program and offers an M.S. in Resource Economics and a Ph.D. in Economics-Marine Resources at the graduate level. Drawing on the Department's extensive research experience in marine resources, the undergraduate program deals with economic issues in commercial fisheries, aquaculture, offshore petroleum, and the uses of other marine resources. Training in Resource Economics at the undergraduate level prepares the student for positions in state, regional, and federal government agencies and for continuing study at the graduate level.

At the graduate level, the Department offers an M.S. degree in Resource Economics. Areas of concentration include aquaculture, fisheries management, the economics of recreation, offshore oil and gas, and land use planning. A close liaison exists with the University's Sea Grant Program, Graduate School of Oceanography, Center for Ocean Management Studies, and International Center for Marine Resource Development. Financial assistance is available.

The Masters program trains students to assume positions with government agencies or in private industry concerned with marine resource management and development. Many M.S. graduates continue graduate studies leading to the Ph.D. degree. The Ph.D. program in Economics - Marine Resources trains students in economic and resource economics theory, marine policy and applied quantitative techniques. Graduates of the program are trained to assume responsible research and teaching positions in government, industry and at academic institutions.

The following undergraduate courses are offered in conjunction with the above program:

REN 105	Introduction to Resource Economics
REN 135	Fisheries Economics
EWN 310	Man and Resource Use
REN 341	Economics of Food Marketing
REN 430	International Resource Development
REN 435	Aquacultural Economics
REN 440	Development and Evaluation of Natural Resource Projects
REN 455	Economics of Land, Forestry and Recreation Resources
REN 460	Economics of Ocean Management
REN 491	Special Projects
REN 492	Special Projects

The following graduate courses are offered in the M.S. and Ph.D. programs:

REN 516	Economics of Marine Resources
REN 527	Macroeconomic Theory
REN 528	Microeconomic Theory
REN 534	Economics of Resource Development I
REN 543	Economic Structure of the Fishing Industry
REN 550	The Economics of Exhaustible Marine Resources
REN 576	Econometrics I
REN 595	Problems of Modernization in Developing Nations
REN 599	Masters Thesis Research
REN 602	Research Methodology
REN 610	Advanced Studies
REN 621	The Estuary and Coastal Zone
REN 628	Advanced Microeconomic Theory
REN 634	Economics of Resource Development II
REN 635	Marine Resources Policy
REN 676	Advanced Econometrics
REN 699	Doctoral Dissertation Research

Except for Masters and Doctoral Dissertation research, which may be for as much as six credits, all the above courses are for three credits each.

The instructional staff for the courses listed above consists of the following:

Gates, John M., Ph.D., Associate Professor
Grigalunas, Thomas A., Ph.D., Associate Professor
Holmsen, Andreas A., Ph.D., Professor
Hueth, Darrell L., Ph.D., Adjunct Associate Professor
Lampe, Harlan C., B.S., Professor
McConnell, Kenneth E., Ph.D., Associate Professor
Opaluch, James J., Ph.D., Assistant Professor
Rorholm, Niels, Ph.D., Professor
Spaulding, Irving A., Ph.D., Professor
Sutinen, Jon G., Ph.D., Assistant Professor
Tyrrell, Timothy, Ph.D., Assistant Professor
Wallace, William H., M.S., Associate Professor
Wang, Stanley, Ph.D., Adjunct Assistant Professor
Weaver, Thomas F., Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. Thomas A. Grigalunas, Chairman
Department of Resource Economics
Lippitt Hall
University of Rhode Island
Kingston, Rhode Island 02881

UNIVERSITY OF SOUTH CAROLINA
Columbia, South Carolina 29208

Facilities for laboratory research are available on campus in the Belle W. Baruch Institute for Marine Biology and Coastal Research, the Electron Microscope Laboratory and the Departments of Biology, Chemistry and Geology. These facilities include equipment for molecular, organismic and field studies. A seven-story, 72,000 square feet building will be completed in Columbia in December of 1980 that will house the Marine Science Program, the

Geology Department and the Belle W. Baruch Institute for Marine Biology and Coastal Research. The building will join the Biology building with the Physics and Chemistry building. In addition, the coastal region offers natural environments unique in the eastern United States. The Baruch Foundation Plantation near Georgetown, South Carolina, a 17,500-acre tract bordering Winyah Bay, North Inlet, and the Atlantic Ocean, offers an undisturbed setting for field investigations. A field laboratory, consisting of ten laboratories supplied by running sea water, a shop, dormitories, boat houses, and numerous small boats equipped for biological, chemical and geological field research are located on the Baruch Plantation. The Santee Delta, the only delta impinging directly on the Atlantic Ocean, Winyah Bay, a large estuary, and Port Royal Sound all lie within easy driving distance of the University campus. The campus and the field facility employ a staff of research scientists, and there are year-round opportunities for visiting investigators and student research at each location. Research equipment includes respirometers, induction salinometers, environmental chambers, cartesian diver, trawls, seines, spectrophotometers, UV irradiators, microscopes, ATP analyzer, specific ion probes, scuba gear, photographic equipment, gas chromatography, micro balances, radiometers, biopulse systems, mercury analyzer, data analyzing systems, ultracentrifuges, oscilloscopes, wave tank and a floating environmental station equipped with current meters, tidal, precipitation and wind guages. The University has an exceptional Computer Services Center with an Amdahl 470-V/6, and a statistical consulting service is available in the Mathematics Department.

Coursework is offered leading to the Bachelor of Science, Master of Science and Doctor of Philosophy degrees in Marine Science. For graduate degrees the following courses are required: biological, geological, physical and chemical oceanography. The remainder of the program of study and other specific degree requirements will be planned in consultation with the Director of the Marine Science Program, the student and his/her advisory committee.

For a B.S. in Marine Science, the student must successfully complete:

1. Basic core courses - Marine Science 101, 102 and 301, 302.
2. Thirty hours in interdisciplinary major subjects including Marine Science 301, and 302.
3. Chemistry 111, 114, and eight hours of physics.
4. Computer Science 271.
5. A calculus sequence.

Upon completion of the freshman year, the student will select an area of specialization consistent with his interests. Specialization may be directed toward an interdisciplinary area of study in the marine sciences, or toward the more traditional disciplines such as biology, chemistry, geography, geology or physics. Each student will plan his individual program in consultation with a faculty advisor.

The following degrees are offered:

1. B.S. in Marine Science:

a) Interdisciplinary or area of specialization in Marine Science	36 credits
b) Mathematics	9 credits
c) Chemistry	9 credits
d) Computer Science	1 credit
e) Physics	8 credits

2. M.S. in Marine Science:

a) Thirty credits including six for thesis research
b) Four core courses in: biological, physical, geological, and chemical oceanography and oceanographic techniques
c) Presentation of a Master's Thesis
d) A comprehensive examination

Six degrees were awarded in 1978.

3. Ph.D. in Marine Science:

a) Completion of four core courses in Marine Science
b) Qualifying examination, written
c) Reading knowledge of one foreign language
d) Reading knowledge of a second foreign language or six hours credit in either statistics or computer science
e) Comprehensive examination
f) Presentation of a dissertation
g) Dissertation defense

Three degrees were awarded in 1978.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

MSCI 101	The Present Day Marine Environment	3
MSCI 102	The Origin and Evolution of the Marine Environment	3
MSCI 210	Oceans and Man	3
MSCI 301	Physical and Chemical Oceanography	4
MSCI 302	Biology of Marine Organisms	3
MSCI 399	Independent Study	3-6
MSCI 501	Principles of Geomorphology	3
MSCI 505	Senior Seminar	1-3
MSCI 511	Advanced Paleontology	3
MSCI 515	Marine Micropaleontology	3
MSCI 521	Geochemistry	3
MSCI 534	Animal Behavior	3
MSCI 545	Geological Oceanography	3
MSCI 566	Ecosystem Analysis	3
MSCI 575	Marine Ecology	4
MSCI 577	Ecology of Coral Reefs	3
MSCI 581	Estuarine Field Measurements	3
MSCI 583	Geology and Geochemistry of Salt Marshes	3
MSCI 585	Coastal Tropical Oceanography	3
MSCI 627	Introductory Phycology	4
MSCI 650	Biological Oceanography	3
BIOL 310	Invertebrate Zoology	4
BIOL 330	Microbiology	4
BIOL 340	Cell Biology	4
BIOL 350	Genetics	4
BIOL 534	Animal Behavior	3
BIOL 543	Comparative Physiology	4
BIOL 549	Plant Physiology	4
BIOL 570	Principles of Ecology	3
BIOL 627	Introductory Phycology	4
BIOL 643	Advanced Microbiology	4
ENGR 223	Statics	3
ENGR 224	Dynamics	3

ENGR 301	Thermodynamic Fundamentals	3
ENGR 306	Fluid Mechanics	3
ENGR 565	Environmental Problems	3
GEOG 202	Weather and Climate	4
GEOG 325	Spatial Organization	3
GEOG 343	Man's Impact on the Environment	3
GEOG 510	Systematic Geography	3
GEOG 543	Computer Mapping	3
GEOG 545	Meteorology	4
GEOG 546	Micro Climatology	4
CHEM 231	Organic Chemistry	3
CHEM 232	Organic Chemistry	3
CHEM 340	Elementary Physical Chemistry	3
GEOL 311	Invertebrate Paleontology	4
GEOL 501	Principles of Geomorphology	4
GEOL 508	Palynology	3
GEOL 511	Advanced Paleontology	3
GEOL 515	Marine Ecology	4
GEOL 516	Sedimentary Geology	3
GEOL 518	Physical Analysis of Sediments	3
GEOL 521	Geochemistry	3
GEOL 546	Marine Geophysics	3
GEOL 570	Introduction to Hydrogeology	3
GEOL 572	Water Quality and Pollution	3
NSCI 301	Navigation and Naval Operations I	3
NSCI 304	Navigation and Naval Operations II	3
GINI 431	Science, Technology and World Affairs	3
GINI 538	Politics and Policies for Ocean Space	3
ECON 548	Environmental Economics	3
SOCY 310	Social Demography	3
SOCY 315	An Introduction to the Study of Population	3
PHYS 212	Essentials of Physics II	4

GRADUATE COURSES

MSCI 501	Principles of Geomorphology	3
MSCI 505	Senior Seminar	1-3
MSCI 511	Advanced Paleontology	3
MSCI 515X	Marine Micropaleontology	3
MSCI 521	Geochemistry	3
MSCI 534	Animal Behavior	3
MSCI 545	Geological Oceanography	3
MSCI 566	Ecosystem Analysis	3
MSCI 575	Marine Ecology	4
MSCI 577	Ecology of Coral Reefs	3
MSCI 581	Estuarine Field Measurements	3
MSCI 583	Geology and Geochemistry of Salt Marshes	3
MSCI 585	Coastal Tropical Oceanography	3
MSCI 627	Introductory Phycology	4
MSCI 650	Biological Oceanography	3
MSCI 750	Advanced Biological Oceanography	3
MSCI 754	Oceanographic Techniques	1
MSCI 758	Special Topics in Marine Science	1-3
MSCI 767	Ecosystem Modeling and Resource Management	3
MSCI 769	Reproductive Ecology	3
MSCI 777	Current Topics in Marine Science	3
MSCI 778	Current Topics in Marine Science	3
MSCI 781	Physical Oceanography	3
MSCI 782	Chemical Oceanography	3
MSCI 799	Thesis Preparation	1-6
MSCI 899	Dissertation Preparation	1-12
BIOL 534	Animal Behavior	3
BIOL 534L	Animal Behavior Lab	1
BIOL 543	Comparative Physiology	4
BIOL 570	Principles of Ecology	3
BIOL 570L	Principles of Ecology Lab	1
BIOL 627	Introductory Phycology	4
BIOL 643	Advanced Microbiology	4
BIOL 651	Limnology	4
BIOL 722	Aquatic Bacteriology	3
BIOL 722L	Aquatic Bacteriology Lab	1
BIOL 728	Advanced Physiology	3
BIOL 729	The Biology of Fish	3
BIOL 730	The Biology of Fish Lab	1
BIOL 731	Advanced Invertebrate Zoology I	3
BIOL 732	Advanced Invertebrate Zoology II	3
BIOL 735	Experimental Embryology	3
BIOL 749	Seminar in Biochemistry	3
BIOL 750	Advanced Biological Oceanography	3
BIOL 759	Physiological Ecology	3
BIOL 760	Electron Microscopy	3
BIOL 760X	Electron Microscopy Lab	1
CHEM 511	Advanced Inorganic Chemistry	3
CHEM 512	Inorganic Lab	1
CHEM 541	Physical Chemistry	3
CHEM 541L	Physical Chemistry Lab	1
CHEM 542	Physical Chemistry	3
CHEM 542L	Physical Chemistry Lab	1
CHEM 729	Special Topics (Pesticide Residue Analysis)	3
CHEM 741	Chemical Thermodynamics	3
CHEM 742	Chemical Thermodynamics	3
ENGR 501a	Engineering Analysis I	3
ENGR 501	Engineering Analysis II	3
ENGR 532	Thermodynamics	3
ENGR 538	Numerical Methods for Computers	3
ENGR 565	Environmental Problems	3
ENGR 566	Ecosystem Analysis	3
ENGR 701	Advanced Heat Transfer	3
ENGR 705	Viscous and Turbulent Flow	3
ENGR 708	Tensor Analysis and Its Applications	3
ENGR 718	Air Pollution Control	3
ENGR 721	Wastewater Treatment	3
GEOG 510	Systematic Geography	3
GEOG 531	Quantitative Methods in Geographical Research	3
GEOG 540	Interpretation of Aerial Photographs	3
GEOG 541	Advanced Cartography	3
GEOG 543	Computer Mapping	3
GEOG 545	Meteorology	4
GEOG 546	Micro-Climatology	4
GEOL 501	Principles of Geomorphology	3
GEOL 508	Palynology	3
GEOL 511	Advanced Paleontology	3
GEOL 516	Sedimentary Geology	3
GEOL 518	Physical Analysis of Sediments	3
GEOL 520	Isotope Geology and Geochronology	3
GEOL 536	Geophysics	3
GEOL 546	Marine Geophysics	3
GEOL 570	Introduction to Hydrogeology	3
GEOL 571	Ground Water Geology	3
GEOL 572	Water Quality and Pollution	3
GEOL 713	Environmental Aspects of Paleontology	3
GEOL 722	Aqueous Geochemistry	3
GEOL 723	Clay Mineralogy	3
GEOL 750	Advanced Stratigraphy	3
GEOL 751	Carbonate Petrology	3
GEOL 753	Shoreline and Littoral Processes	3
GEOL 756	Deltaic Sedimentation	3
GINT 604	The Tradition of Natural Law	3
LAW	Environmental Law	

MATH 514	Stochastic Processes	3
MATH 515	Statistical Methods	3
MATH 516	Statistical Methods	3
MATH 518	Nonparametric Statistical Methods	3
MATH 520	Ordinary Differential Equations	3
MATH 521	Boundary Value Problems and Partial Differential Equations	3
MATH 526	Numerical Analysis I	4
MATH 527	Numerical Analysis II	4
MATH 544	Linear Algebra	3
MATH 700	Applied Statistics	3
MATH 701	Applied Statistics	3
MATH 722	Vector Analysis	3
MATH 723	Partial Differential Equations	3
MATH 724	Partial Differential Equations	3
MATH 726	Numerical Analysis I	3
MATH 727	Numerical Analysis II	3
PHYS 503	Mechanics	4
PHYS 506	Kinetic Theory and Statistical Mechanics	3
PUBH 761	Environmental Physiology	3

The instructional staff for the Marine Science Program is as follows:

Bidleman, T.F., Ph.D., Assistant Professor of Chemistry
Bonnell, R.D., M.E., Professor of Modeling
Colquhoun, D.J., Ph.D., Professor of Geology
Coull, B.C., Ph.D., Professor of Biology
Dean, J.M., Ph.D., Professor of Biology
DeCoursey, P.J., Ph.D., Associate Professor of Biology
Gardner, R.G., Ph.D., Associate Professor of Geology
Hayes, M.O., Ph.D., Professor of Geology
Kjerfve, B., Ph.D., Associate Professor of Geology
Lawrence, D.R., Ph.D., Associate Professor of Geology
McKellar, H.N., Ph.D., Assistant Professor of Modeling
Moore, W.S., Ph.D., Associate Professor of Geology
Stancyk, S.E., Ph.D., Assistant Professor of Biology
Stevenson, L.H., Ph.D., Associate Professor of Biology
Vernberg, F.J., Ph.D., Professor of Biology
Vernberg, W.B., Ph.D., Professor of Biology
Watabe, N., D.Sc., Professor of Biology
Williams, D.F., Ph.D., Assistant Professor of Geology
Zingmark, R.G., Ph.D., Associate Professor of Biology

To obtain further information, address inquiries to:

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Marine Science Program
University of South Carolina
Columbia, South Carolina 29208

UNIVERSITY OF SOUTHERN CALIFORNIA
INSTITUTE FOR MARINE AND COASTAL STUDIES
Los Angeles, California 90007

The Institute for Marine and Coastal Studies (IMCS) was established in 1975 by the University of Southern California to manage and develop the University's extensive marine programs and facilities, many of which have been in existence since the early 1900's. The Institute supports teaching and research in three principal areas: marine science (oceanography), ocean engineering, and marine policy (law, economics, political science, etc.). More than 100 courses are taught in these disciplines in some 14 departments, colleges, and professional schools at USC. Many of the Institute's professional staff hold joint appointments with other departments.

Marine science courses are offered at both the main campus in downtown Los Angeles and at the Catalina Marine Science Center on Santa Catalina Island, 22 miles offshore from the Los Angeles coastal plain. In addition, field work is conducted on the research vessel, the Velero IV, a 100-foot Pacific Tuna Clipper Design vessel. The IMCS also operates a coastal research vessel, the 65-foot Sea Watch; the 37-foot Golden West, equipped for diving support and nearshore sampling; and the 28-foot Espoir, used for commuting equipment and personnel to and from the Catalina Marine Science Center. All are located at the Marine Support Facility in Wilmington, which also houses an Oceanographic Instrumentation Calibration Center, the Harbors Research Laboratory for on-location harbor studies, and the Marine Advisory Services component of the Institute's Sea Grant Program.

The Catalina Marine Science Center provides extensive laboratory and living facilities for scientists and students in a well-protected marine environment. The Center includes a 30,000 square foot laboratory building with classrooms, a lecture hall, and a library. Specific capabilities include:

- Fresh seawater circulating systems for all laboratories
- Microtechnique laboratories
- Herbarium
- Zoological museum
- Cold room
- Constant Temperature room
- Two environmental chambers
- Electron microscope
- Machine shop

The Center operates several small boats, a diving support complex (with air compressor, two diver-propulsion vehicles, underwater television equipment, surface-air gear, and underwater communications equipment), one of three hyperbaric chambers on the west coast (used for treatment of diving victims and for physiological research), and a marine railway for launching and retrieving manned submersibles. Planned improvements include a larger pier which will allow for docking of large research vessels, and a helipad, which will facilitate emergency operations for incoming diving victims. Both are scheduled for completion in late 1979.

The Center offers a year-round program of courses in cooperation with the Department of Biological Sciences and the School of Medicine. One of these, the Catalina Semester, allows students the opportunity to spend a semester at the Center for two 7½-week sessions. Formal classes are held 5½ days a week, and sample courses include: Marine Phycology, Marine Biology, Marine Invertebrate Zoology, Biological Oceanography, Ichthyoplankton, Underwater Research, Neurosciences, and Hyperbaric Physiology.

Also on Catalina Island is the new Mt. Ada Marine Conference Center in Avalon. Mt. Ada was once the Catalina home of Mr. and Mrs. William Wrigley, Jr. It was donated to the University in 1978 for use as an academic and cultural center, capable of accommodating up to 100 conference participants. Ample commercial lodging facilities are located within walking distance of the Center.

On-campus facilities for marine research range from a major central computing facility (along with several auxiliary systems) to specialized laboratories for various areas of marine biology, marine geology, geophysics, geochemistry, ecology, oceanography, coastal and ocean engineering, and paleoecology. The Allan Hancock Foundation's Library for Oceanography and Marine Biology, aside from containing several thousand volumes on numerous marine science specialties, also produces a monography series devoted to basic and applied research, field surveys, and data reports in the marine sciences. The Hancock Foundation possesses one of the largest collections of marine invertebrates and algae on the Pacific Coast.

The Institute's diversified research program totals about $4 million yearly. Its largest single component, the Sea Grant Institutional Program, is concerned primarily with the planning and management of California's coastal resources. Funded by the National Oceanic and Atmospheric Administration, the State of California, and other sources, Sea Grant deals with marine resource development (living and non-living), environmental quality, coastal zone management, and marine education.

The greater Los Angeles region is a virtual laboratory for the student of marine science. Los Angeles has the second largest port complex in the United States, the largest fishing port, and segments of nearly every maritime industry. Thus, marine research problems abound in the loca area, and various IMCS programs address specific research problems endemic to the local area. The Harbors Environmental Projects, for example, have played a major role in accumulating and analyzing sound scientific information concerning the Los Angeles/Long Beach Harbor areas. Data from Harbor Projects' reports has been used extensively in environmental statements and assessments.

Much of the Institute's research, however, deals with ocean problems of universal importance which extend beyond California's geographical boundaries. In addition to basic problems in marine biology, geology, oceanography, and coastal engineering, there are complex political and social issues which receive a great deal of attention from the Institute's diverse professional staff of marine engineers, biologists, geologists, social policy analysts, and legal experts, who frequently combine their skills in the search for adequate solutions. This reflects the multidisciplinary approach to marine studies at USC.

Some of the Institute's programs have very specific research goals, such as the new Marine and Freshwater Biomedical Center. In 1978, the National Institutes of Environmental Health Sciences designated USC as one of four universities nationwide to establish such a center. The Center focuses its research on cardiovascular, neurobiologic, and carcinogenic problems in marine fish and mammals as they apply to humans.

A new Center for Marine Transportation Studies will begin teaching and research activities in early 1980. Designed to bring together the disciplines of public administration, business administration, and marine science, the Center will offer graduate degrees and certificates in marine transportation. The Center's purpose will be to train managers in various aspects of ocean trade, transportation, and port and harbor management within the framework of a graduate academic program. The Center will also sponsor seminars, workshops, and short courses to bring together professionals already in the field.

ACADEMIC PROGRAMS

USC offers a wide range of academic possibilities for the prospective marine sciences student. Seven advanced degree programs are available in marine science specialties in the departments listed below:

1. M.S./Ph.D. in Biological Sciences with marine science emphases are offered by the Department of Biological Sciences. The Department offers approximately 41 graduate and undergraduate courses in various marine science topics. Nearly 50 percent of the department's faculty have marine biology specializations. Basic requirements are:

   M.S.: Three full biology graduate courses, two seminars, and additional graduate courses and/or research units for a total of at least 24 units; thesis required.

   Ph.D.: Five full graduate courses, six seminars and additional graduate units for a total of 60 units; qualifying examination and dissertation required. After admission into the Ph.D. in Biological Sciences program, students are given a background examination in the major fields of biology. Students prepare a curriculum of course and research training in consultation with their advisory and guidance committee. Although the qualifying examination in the second year is common to all doctoral students, considerable specialization is allowed for those engaged in marine science areas. Shipboard- and teaching assistance-experience is required for students involved in relevant oceanic biology areas. Thesis topics nad other specific areas of research will be defined mainly by faculty interests, and an ability to undertake independent research is demanded. Laboratories exist in Science Hall, the Hancock Foundation Building, and the Ahmanson Center for Biological Research, in addition to the extensive facilities of the Catalina Marine Science Center. Courses are offered both on campus and at the Center.

2. M.S. and Ph.D. in Geological Sciences with marine science specializations offered. The Department of Geological Sciences has a faculty of over 50 percent in marine sciences, and 23 undergraduate and graduate courses in marine specialties are offered. Fourteen faculty members teach and conduct research in a wide range of areas from bottom topography to environmental aspects of coastal geology. Since 1960, 26 Ph.D. dissertations and 50 Master's

dissertations have been published in the marine sciences. The degree specializations fall into two categories:

a) Ph.D. in Geology with specialization in Marine Geology, Geophysics and Geochemistry of the Oceans. The requirements for the doctorate follow the general requirements of the Graduate School and usually require a minimum of four years to complete. Only students of high ability are accepted as candidates after demonstrating their competence in a screening examination in the first year, a comprehensive written and oral examination after two years, and the successful defense of the original dissertation. Usually the student is required to successfully demonstrate a reading knowledge of one foreign language, or they may substitute their competence in statistics of computer use or an advanced basic science minor. The path of the student's studies are directed by the Guidance Committee following the successful passing of the screening examination. There were eight graduates of this program last year.

b) M.S./M.A. in Geological Sciences with specialization in Marine Geology and Oceanography. Master's degree candidates must have the same entrance qualifications as above and must have passed 24 hours of graduate work with a grade point average of 3.0/4.0. A thesis is required. The master's committee is selected after the screening examination of the first year is successfully completed. The master's is generally required before the Ph.D. can be sought except in cases of exceptional ability. A master's degree normally requires two years to complete. There were four graduates of the program last year.

3. M.S. in Ocean Engineering. Offered by the Department of Aerospace Engineering, the M.S. in Ocean Engineering is directed toward preparing students for a professional career in one of many ocean-engineering oriented activities. The program is interdisciplinary in nature and flexible enough to satisfy the needs of individual students with a variety of backgrounds and interests. Applicants with a bachelor's degree in any area of engineering or science who have the ability to pursue graduate study are eligible for this program. The program consists of 27 semester units or equivalentyly nine courses. Thesis work at the Master's level is optional. The program can be completed in three semesters of work, although it is possible to satisfy the requirements in two semesters. Possible fields of specialization include: ocean dynamics, coastal engineering, and ocean structures. Other possible areas include ocean communications, systems design, public administration, system safety, and marine pollution.

4. M.S. in Environmental Engineering. Offered by the Department of Environmental Engineering, the M.S. program is intended to prepare students for a professional career in any one of many environmental engineering activities. It is interdisciplinary in nature; applicants with a bachelor's degree in any area of engineering or science who have the ability to pursue graduate study are eligible for this program. Students are required to take coursework and pass a comprehensive examination; normally, it requires one academic year of full-time study beyond the B.S. level. Possible areas of specialization include ocean waste management, water pollution problems, and ecosystems.

5. Marine Policy Programs. Arrangements have been made to include a marine affairs program as an acceptable field for specialized doctoral study in the School of International Relations, the School of Public Administration, the Department of Economics, and the Department of Political Science. Students wishing to do marine affairs work at the graduate level are encouarged to apply for enrollment into one of these more general disciplines at USC. In addition, joint programs in Environmental Management can be arranged between the School of Urban and Regional Planning and other schools and departments. Examples would be joint Master's programs in Planning/Public Administration, Planning/Law, or Planning/Business.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

BIOLOGICAL SCIENCES

100	Cells and Organisms	4
102	Man and His Environment	4
106abL	General Biology	4
215L	Ecological and Evolutionary Biology	4
301L	Fundamentals of Invertebrate Biology	4
302L	Fundamentals of Vertebrate Biology	4
331L	Comparative Morphology	4
404L	Ecology	4
416x	Oceanography Workshop I	2
417x	Oceanography Workshop II	2
418L	Marine Microbiology	4
419	Environmental Microbiology	4
469L	Marine Biology	4
470L	Ichthyology	4
471L	Marine Invertebrate Zoology	4
472L	Marine Phycology	4
473L	Biological Oceanography	4
474L	Systems Ecology	4
481L	Development of Biology of Marine Animals	4

ECONOMICS

438	Economics of Technology	4
455	Urban and Regional Economics	4
476	Economics of Less Developed Countries	4

ENGINEERING, AEROSPACE

470	Man's Influence on His Environment, Pollution, and Control	3
471	Introduction to Ocean Engineering	3

ENGINEERING, BIOMEDICAL

403ab	Physiological Systems	3

ENGINEERING, CIVIL

443	Environmental Chemistry	3
451	Water Resources Engineering	4
453	Water Quality Control	3
463L	Environmental Engineering Laboratory	3
465	Water Supply and Sewage System Design	3
471	Principals of Transportation Engineering	3

GEOLOGICAL SCIENCES

105	Physical Geology	4
106	Interpreting Earth History	4
107	Elements of Oceanography	4
206	Mineralogy	4
215	Igneous and Metamorphic Petrology	4
321	Structural Geology	4
333	Paleontology	4
334	Stratigraphy and Sedimentation	4
412	Oceanography for Engineers and Scientists	4
440	General Geophysics	4
457	Petroleum Geology	4
465	Summer Field Geology	4

INTERNATIONAL RELATIONS

425	Problems of a Global Science	4
430	The World Political Economy: Its Development Since 1780	4
485	International Organization	4
489	Economics of the World Environmental Crisis	4

POLITICAL SCIENCE

435	Politics and the Economy	4
436	Environmental Politics	4
451	Politics of Resources and Development	4

URBAN AND REGIONAL PLANNING

426	History and Evolution of Cities and the Urbanization Process	4
430	Planning, Policymaking, and Social Change	4

GRADUATE COURSES

BIOLOGICAL SCIENCES

519	Recent Advances in Marine Biology	2-8
522	Tropical Marine Biology	8
531	Seminar in Marine Invertebrate Zoology	2
541L	Protozoology	4
546L	Crustacean Biology	4
547	Malacology	4
548L	Advanced Methods in Underwater Research	4
550	Advanced Neurophysiology	4
560L	Marine Environmental Impacts	4
562L	Natural History of Santa Catalina Island	4
563L	Electrobiology	4
568L	Advanced Marine Invertebrate Biology	4-8
569	Oil Pollution of the Marine Environment	3
573L	Marine Ecology	4
574L	Marine Plankton Ecology	4
575abL	Biology of California Marine Fishes	4-4
579L	Island Ecology	4
581L	Current Problems in Marine Sciences	4-16
582L	Oceanology	4
583L	Comparative Physiology of Marine Animals	4
586L	Developmental Biology of Marine Organisms	4
599	Special Topics	2-12

ECONOMICS

503	Microeconomic Theory I	4
505	Macroeconomic Theory I	4
536	Economics of Regulated Industries	4
550	International Trade Theory	4
554	Economic Analysis for International Relations	4
555	Regional, Spatial, and Environmental Economics	4
556	Urban Economics	4
575	Problems of Underdeveloped Economies	4

ENGINEERING, AEROSPACE

510ab	Dynamics of Incompressible Fluids	3-3
525ab	Engineering Analysis	3-3
575	Advanced Analytical Methods in Engineering	3-3
518	Ocean Measurements	3
620	Aero and Hydrodynamic Wave Theory	3
623ab	Dynamics of Stratified and Rotating Flows	3-3
624ab	The Fluid Dynamics of Natural Phenomena	3-3

ENGINEERING, BIOMEDICAL

502L	Bioinstrumentation	3
688	Models of Cardipulmonary Systems	3

ENGINEERING, CIVIL

503	Microbiology for Environmental Engineers	3
507	Mechanics of Solids I	3
513L	Instrumental Methods of Environmental Analysis	3
518	Seminar in Environmental Engineering	2
520ab	Ocean and Coastal Engineering	3-3
529ab	Matrix Structural Analysis	3-3
531	Soil Mechanics and Foundation Engineering II	3
534	Waterfront and Waterway Construction	3
541ab	Dynamics of Structures	3-3
542	Theory of Plates	3
543	Stability of Structures	3
544	Theory of Shell Structure	3
555	Underwater Structures	3
562ab	Hydromechanics	3-3
563	Chemistry and Biology of Natural Water	3
583	Design of Transportation Facilities	3

ENGINEERING, ELECTRICAL

581	Sonar Signal Processing	3
582	Digital Signal Processing	3
587	Control System Design	3

ENGINEERING, ENVIRONMENTAL

501	Resource Recovery	3
512	Environmental Impact Statements	3
505	Energy and the Environment	3
506	Ecology for Environmental Engineers	3
507ab	Environmental Systems Analysis	3-3
513L	Instrumental Methods for Environmental Analysis	3
517	Industrial Waste Treatment	3
553	Chemical and Biological Processes in Environmental Engineering	3

ENGINEERING, INDUSTRIAL AND SYSTEMS

541	Systems Engineering Methodology	3
570	Human Factors in Engineering	3

ENGINEERING, MECHANICAL

501	Materials and the Ocean Environment	3
507	Ocean Equipment Design	3
508	Design for the Ocean Environment	3
511	Ocean Propulsion and Power Systems	3
529	Underwater Acoustics	3

GEOLOGICAL SCIENCES

500	Marine Paleoecology	3
510	Sedimentary Processes	3
511	Sedimentary Techniques	3
512	Oceanography I	3
514	Marine Geology	3
519	Sedimentary Petrography	3
521	Taxonomy	3
528	Seminar in Remote Sensing	3
531	Geotectonics	3
550	Chemical Equilibria in Geology	3
551	Special Problems in Environmental Geology	3
560	Marine Geochemistry	3
563	Oceanography II	3
564	Isotope Geochemistry	3
565	Seminar on Estuarine Processes	3
566	Geochemistry Seminar	1-4
571	Environmental Analysis of Sedimentary Rocks	3-3
577	Micropaleontology	3
578	Advanced Micropaleontolgy	3
590	Directed Research	1-12
600	Seminar	2-6
650	Recent Advances in Paleontology	3
790	Research	1-12

INTERNATIONAL RELATIONS

504	Science, Technology, and Politics	4
506	International Organizational Processes	4
521	Introduction to Foreign Policy Analysis	4
541	Politics of the World Economy	4
545	The Political Economy of Development	4
549	Economic Analysis for International Relations	4

MEDICINE

580L	Advanced Methods in Underwater Research	4
626	Hyperbaric Physiology	4
630	Physiopharmacology of Toxins	4

POLITICAL SCIENCE

540	Law and Public Policy	4
671	Ocean Law and Policy	4

PUBLIC ADMINISTRATION

550	Environmental and Resource Administration	4
557	Ocean and Coastal Zone Problems	4
559	Energy Policy and Resource Development	4
575	Science, Technology, and Government	4
576	Systems Analysis for Public Projects	4
577	Problems in Research and Development Administration	4

SOCIOLOGY

540	Methods of Population and Ecological Analysis	4
542	Seminar in Human Ecology	
543	Seminar in Urban Structure	

URBAN AND REGIONAL PLANNING

622	Land Use Controls and Other Tools of Physical Planning Effecutation	4
623	Politics of Planning and the Urban Environment	4
631	Seminar in Regional Analysis and Planning	4
632	Regional Planning in Developing Areas	2
635	Seminar in Urban Development	
668	Urban Policy Evaluation Techniques	4
670L	Core Laboratory-Workshop	4

The instructional staff for the courses listed above consists of the following:

INSTITUTE OF MARINE AND COASTAL STUDIES PROFESSIONAL STAFF

Brewer, Cary D., Ph.D., Research Scientist
Dickey, Tommy D., Ph.D., Research Associate
Dugdale, Richard C., Ph.D., Associate Director, Marine Sciences
Friedheim, Robert L., Ph.D., Associate Director for Marine Policy
Given, Robert, Ph.D., Director, Catalina Marine Science Center
Greer, Hugh D., Ph.D., Adjunct Research Scientist
Hodara, Henri, Ph.D., Adjunct Senior Research Associate
Keach, Donald L., B.S., Deputy Director; Director, Sea Grant Program
Krueger, Robert B., J.D., Adjunct Research Fellow
Linaweaver, Paul G., Jr., M.D., Adjunct Senior Research Scientist
Oguri, Mikihiko, M.S., Research Associate and Associate Director, Harbors Environmental Projects
Pardo, Arvid, LL.D., Senior Research Fellow
Pieper, Richard, Ph.D., Associate Director for Research, Catalina Marine Science Center
Pilmanis, Andrew A., Ph.D., Research Associate; Associate Director, Catalina Marine Science Center
Puffer, Harold W., Ph.D., Research Associate and Director, Marine and Freshwater Biomedical Center
Soule, Dorothy F., Ph.D., Senior Research Scientist and Director, Harbors Environmental Projects
Straughan, Dale M., Ph.D., Senior Research Scientist
Walsh, Don, Ph.D., Director

DEPARTMENT OF BIOLOGICAL SCIENCES/ALLAN HANCOCK FOUNDATION

Abbott, Bernard C., Ph.D., Professor and Chairman; Director, Alan Hancock Foundation
Bakus, Gerald J., Ph.D., Associate Professor

Brusca, Richard C., Ph.D., Assistant Professor
Dunn, Arnold, Ph.D., Professor
Garth, John S., Ph.D., Emeritus Professor
Haig, Janet, Ph.D., Research Associate, Hancock Foundation
Jones, Gilbert F., Ph.D., Associate Professor
Kastendiek, Jon, Ph.D., Assistant Professor
Kiefer, Dale, Ph.D., Assistant Professor
Kremer, James N., Ph.D., Assistant Professor
Kremer, Patricia, Ph.D., Hancock Fellow
Kudenov, Jerry, Ph.D., Assistant Professor
Lavenberg, Robert, Ph.D., Adjunct Associate Professor
Martin, Walter E., Ph.D., Emeritus Professor
McClure, William O., Ph.D., Associate Professor
Nafpaktitis, Basil, Ph.D., Professor
Ross, Maria, Ph.D., Research Associate, Hancock Foundation
Savage, Jay M., Ph.D., Professor and Associate Director, Hancock Foundation
Soule, John D., Ph.D., Professor
Sullivan, Cornelius D., Ph.D., Assistant Professor
Young, David, Ph.D., Assistant Professor
Zimmer, Russel, Ph.D., Associate Professor

ECONOMICS

Eckert, Ross D., Ph.D., Associate Professor
Gordon, Peter, Ph.D., Associate Professor
Richardson, Harry, M.A., Professor

ENGINEERING

Browand, Frederick K., Ph.D., Associate Professor, Aerospace and Ocean Engineering
Butler, Stanley S., M.S., P.E., Associate Professor, Civil Engineering
Chen, Kenneth Y., Ph.D., Professor, Civil and Environmental Engineering
Devinny, Joseph S., Ph.D., Assistant Professor, Civil and Environmental Engineering
Kaplan, Richard E., Ph.D., Sc.D., Professor of Aerospace Engineering
Laufer, John, Ph.D., Professor and Chairman, Aerospace Engineering
Lee, J.J., Ph.D., Associate Professor, Civil Engineering
Masri, Sami F., Ph.D., Professor, Civil Engineering
Maxworthy, Tony, Ph.D., Professor of Aerospace and Mechanical Engineering; Chairman, Mechanical Engineering
Siegel, Martin, M.S., Associate Professor, Mechanical Engineering
Troesch, B. Andreas, Ph.D., Professor of Aerospace Engineering and Mathematics
Walsh, Don, Ph.D., Professor of Aerospace and Ocean Engineering; Director, Institute for Marine and Coastal Studies
Weingarten, Victor I., Ph.D., Professor and Chairman, Civil Engineering

GEOLOGICAL SCIENCES

Anderson, J. Lawford, Ph.D., Associate Professor
Bottjer, David J., Ph.D., Assistant Professor
Davis, Gregory A., Ph.D., Chairman and Professor
Dickey, Tommy D., Ph.D., Assistant Professor
Douglas, Robert G., Ph.D., Professor
Easton, William H., Ph.D., Professor
Gorsline, Donn S., Ph.D., Professor
Hammond, Douglas E., Ph.D., Associate Professor
Henyey, Thomas L., Ph.D., Associate Professor
Ku, Teh-Lung, Ph.D., Professor
Osborne, Robert H., Ph.D., Professor
Pipkin, Bernard W., Ph.D., Associate Professor
Sammis, Charles G., Ph.D., Associate Professor
Teng, Tai-liang, Ph.D., Professor

HANCOCK FOUNDATION CURATORIAL STAFF

Bakus, Gerald J., Ph.D. (Sponges)
Brusca, Richard C., Ph.D. (Crustaceans)
Garth, John S., Ph.D., Emeritus Curator
Haig, Janet, Ph.D., Asistant Curator
Kastendiek, Jon, Ph.D. (Echinoderms)
Kudenov, Jerry, Ph.D. (Marine Annelids)
Lavenberg, Robert J., Ph.D. (Fishes)
McLean, James H., Ph.D. (Molusks)
Nafpaktitis, Basil, Ph.D. (Fishes)
Soule, Dorothy F., Ph.D., Curator
Soule, John D., Ph.D. (Bryozoans)
Young, David, Ph.D. (Algae)

INTERNATIONAL RELATIONS

Aronson, Jonathon, Ph.D., Assistant Professor
Friedheim, Robert L., Ph.D., Professor; Associate Director for Marine Policy, Institute of Marine and Coastal Studies
Rosenau, James, Ph.D., Professor

LAW

Krueger, Robert B., J.D.

MEDICINE

Meehan, John P., M.D., Professor, Physiology
Puffer, Harold W., Ph.D., Assistant Professor, Physiology
Russell, Findlay E., Ph.D., Professor, Neurology and Physiology
Scott, Richard S., M.D., Assistant Professor, Emergency Medicine

POLITICAL SCIENCE

Christol, Carl Q., Ph.D., Professor
Pardo, Arvid, LL.D., Professor
Schmidhauser, John R., Ph.D., Professor and Chairman
Totten, George O., Ph.D., Professor

PUBLIC ADMINISTRATION

Price, Willard, Ph.D., Associate Professor
Siegel, Gilbert B., Ph.D., Associate Professor and Dean

SOCIOLOGY

Van Arsdol, Maurice D., Ph.D., Professor; Director, Population Research Laboratory

URBAN AND REGIONAL PLANNING

Baer, William C., Ph.D., Associate Professor and Director
Banerjee, Tridib, Ph.D., Associate Professor
Kreditor, Alan, M.C.P.

To obtain further information, address inquiries to:

Dr. Don Walsh, Director
Institute for Marine and Coastal Studies
University of Southern California
University Park
Los Angeles, California 90007
(213) 741-6840

UNIVERSITY OF SOUTHERN MISSISSIPPI
Hattiesburg, Mississippi 39401

The University is a part of the Mississippi-Alabama Sea Grant Consortium and a member of the Gulf Universities Research Consortium. The Department of Biology is closely affiliated with the Gulf Coast Research Laboratory (GCRL) at Ocean Springs, Mississippi, 90 miles away. This association allows use of the research vessels Hermes and Gulf Researcher, in addition to small vessels available for shoreline studies, plus space, equipment and library facilities at GCRL. The department also utilizes the facilities of the National Marine Fisheries Service vessel, R/V Oregon on a space available basis.

The Department of Geology also cooperates closely with the GCRL.

The following degrees are offered in the basic sciences:

1. Ph.D. in Marine Biology. The Department of Biology offers a Ph.D. degree with majors in marine biology and in botany and zoology. All doctoral degrees entail a minimum of 78 semester hours of coursework beyond the bachelor's degree or 48 semester hours of coursework beyond the master's degree. Thirty-two semester hours must be spent on the Hattiesburg campus. A final oral examination is administered after the dissertation is accepted.

There were two Doctor of Philosophy degrees awarded in 1977-1978.

2. M.S. in Biology. Candidates for the master of sciences degree or the master of arts degree must earn 30 semester hours of graduate credit, 12 of which should be in a minor area. A final oral comprehensive examination and an acceptable thesis are required.

There were nine M.S. degrees awarded in 1977-1978.

3. M.S. in Geology. Candidates for the master of science degree must earn 30 semester hours of graduate credit. In addition, a candidate must elect a minor (12 hours) in an approved field and present an acceptable thesis which must be defended.

There were two M.S. degrees awarded in 1977-1978.

Marine science courses are offered by the Departments of Biology and Geology during the regular academic year. Summer courses in marine biology and geology are offered at the Gulf Coast Research Laboratory.

The following courses are offered:

DEPARTMENT OF BIOLOGY

553	Aquatic and Marsh Plants	3
567	Introduction to Biological Oceanography	3
581	Marine Vertebrate Zoology (GCRL)	6
583	Marine Invertebrate Zoology I (GCRL)	6
584	Marine Invertebrate Zoology II (GCRL)	6
585	Parasites of Marine Animals (GCRL)	6
588	Introduction to Marine Zoology (GCRL)	4
589	Marine Botany (GCRL)	4
692	Special Problems in Biology	6
698	Thesis	6
728	Planktology	3
731	Physiology of Marine Animals	3
760	Topics in Marine Biology	2
763	Fisheries Biology	3
765	Biological Oceanography	3
767	Marine Ecology	3
781	Marine Fisheries Biology (GCRL)	6
786	Marine Phycology (GCRL)	6
787	Research in Marine Biology (GCRL)	6
792	Special Problems	6
793	Research Zoology	6
898	Dissertation	6

DEPARTMENT OF GEOLOGY

505	Sedimentology	3
520	Elements of Geophysics	3
526	Advanced Geophysics	3
541	Paleoecology	3
543	Micropaleontology	3
550	Introduction to Geological Oceanography	3
552	Physical Marine Geology (GCRL)	6
554	Chemical Marine Geology (GCRL)	6
556	Problems in Marine Sedimentation (GCRL)	6
703	Sedimentary Environments	3
791	Problems in Geology	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGY

Anderson, Gary, Ph.D., Associate Professor
Cliburn, Joseph W., Ph.D., Professor
Fish, Arthur G., Ph.D., Associate Professor
Grantham, Billy J., Ph.D., Chairman and Professor
Larsen, James B., Ph.D., Associate Professor
Norris, Don, Ph.D., Professor
Pessoney, George F., Ph.D., Professor
Ross, Stephen T., Ph.D., Associate Professor
Wooten, Jean W., Ph.D., Associate Professor

DEPARTMENT OF GEOLOGY

Bowen, Richard L., Ph.D., Professor
Paulson, Oscar L., Ph.D., Chairman and Professor
Sundeen, Daniel A., Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. Robert T. van Aller
Dean of the Graduate School
University of Southern Mississippi
Hattiesburg, Mississippi 39401

UNIVERSITY OF SOUTH FLORIDA
St. Petersburg, Florida 33701

The Department of Marine Science of the University of South Florida is an interdisciplinary unit offering the Master's degree in biological, chemical, geological or physical oceanography. An undergraduate degree is not offered.

Teaching and research laboratories, offices, large and small vessel facilities of the department are located on the St. Petersburg campus. This campus occupies a peninsula about one block wide and two blocks long that extends into Bayboro Harbor, a protected bay opening into Tampa Bay. There are a number of buildings providing adequate space for faculty and graduate students and housing research and teaching equipment. The department operates a fleet of small boats, including two inboard vessels of 36 feet in length, and a number of boats powered by one or two outboard motors. A field station providing overnight accommodations as well as laboratory facilities is maintained near Tarpon Springs, about 35 miles north of St. Petersburg.

The research program of the Department of Marine Sciences includes both inshore environmental studies and offshore oceanography. Faculty members serve as chief scientists and are accompanied by their graduate students on six or eight cruises a year on research vessels. In addition, cruises on smaller vessels are provided by the office of the state university system Institute of Oceanography, located on the St. Petersburg campus. Inshore environmental studies extend from the Florida Keys to the west side of the Mississippi delta. Offshore studies are concerned primarily with the Gulf of Mexico and the Caribbean Sea, though not limited to these areas.

Students in the master's degree program are required to complete 45 quarter hours of graduate level courses which must include three of the four basic graduate courses: biological, chemical, geological and physical oceanography. A thesis is required, for which nine quarter hours credit is allowed.

Most graduate students in the program are supported by half-time research assistantships.

The following courses are examples of those offered as part of or in conjunction with the master's degree in marine science:

OGY 521	Chemical Oceanography	4
OGY 531	Geological Oceanography	4
OGY 541	Physical Oceanography	4
OGY 551	Biological Oceanography	4
OGY 583	Selected Topics in Oceanography	1-4
OGY 610	Scientist-in-the-Sea I, Hyperbaric Operations	4
OGY 611	Scientist-in-the-Sea II, Research Techniques	4
OGY 612	Scientist-in-the-Sea III, Underwater Engineering	4
OGY 622	Methods in Chemical Oceanography	2
OGY 632	Methods in Geological Oceanography	2
OGY 633	Sedimentary Petrology of the Oceans	4
OGY 642	Methods in Physical Oceanography	2
OGY 643	Oceanographic Engineering	4
OGY 650	Marine Algal Ecology	3
OGY 651	Marine Plankton Systematics	4
OGY 652	Methods in Biological Oceanography	2
OGY 653	Marine Plankton Ecology	4
OGY 656	Benthic Marine Ecology	5
OGY 683	Selected Topics in Oceanography	1-4
BIO 543	Phycology	5
BIO 547	Marine Botany	5
BIO 519	Ichthyology	5
BIO 520	Biology of Echinoderms	5
BIO 546	Marine Invertebrate Zoology	5
BIO 623	Physiology of Marine Animals	5
CHM 661	Marine Chemistry	4
GEO 621	Marine Micropaleontology	6

The instructional staff for the courses listed above includes the following:

Baird, Ronald C., Ph.D., Assistant Professor
Betzer, Peter R., Ph.D., Assistant Professor
Blake, Norman J., Ph.D., Assistant Professor
Carder, Kendall L., Ph.D., Assistant Professor
Doyle, Larry J., Ph.D., Assistant Professor
Fanning, Kent A., Ph.D., Assistant Professor
Hopkins, Thomas L., Ph.D., Assistant Professor
Humm, Harold J., Ph.D., Professor
Pyle, Thomas E., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. Harold J. Humm, Chairman
Department of Marine Science
University of South Florida
St. Petersburg, Florida 33701
(813) 898-7411

UNIVERSITY OF SOUTHWESTERN LOUISIANA
Lafayette, Louisiana 70504

The principal research and teaching facilities of the University are located on the main campus in Lafayette, Louisiana. Additionally the University maintains a marine field station on the western shore of Vermilion Bay about 30 miles from the main campus. The University is also an active participant in the newly formed Louisiana Universities Marine Consortium and will have future access to planned Consortium laboratory facilities and larger research vessels which will be located in Cocodrie, Louisiana, about 120 miles from the main campus. Access to other marine environments is often available through cooperative programs with state and federal agencies. Marine research and education opportunities are also provided on an occasional basis through the USL Tropical Field Expedition program which to date has centered on studies along the east coast of Mexico.

The University presently operates one 30-foot research vessel and about 10 smaller outboards and skiffs. A wide array of sampling equipment is available for marine field studies. Campus facilities include a variety of marine research and teaching laboratories in the Biology, Geology, and Microbiology Departments. Special facilities include a newly completed wing of the Biology Department which houses wet labs, cold rooms, environmental rooms, systematic collections, instrument laboratories, and photography laboratories. Space is also provided for a scanning electron microscope which will be acquired in the near future. Other specialized research equipment available on campus includes a transmission electron microscope, highly advanced computer facilities, instrumentation for chemical and physiological analyses, sediment analysis equipment, and a variety of research quality light microscopes.

No degrees are specifically entitled as marine science, but marine studies may be emphasized by students in chosing courses toward the following degree programs:

1. Bachelor of Science in Botany (two granted in 1978-1979).
2. Bachelor of Science in Aquatic and Fishery Biology (five granted in 1978-1979).
3. Bachelor of Science in Wildlife Management (eight granted in 1978-1979).
4. Bachelor of Science in Zoology (four granted in 1978-1979).
5. Bachelor of Science in Microbiology (17 granted in 1978-1979).
6. Bachelor of Science in Geology (16 granted in 1978-1979).

General requirements for the above degrees include (i) a minimum of 124 semester hours successfully completed toward a degree program, (ii) a minimum grade point average of 2.0, (iii) minimum residence requirements of two semesters and 30 credit hours, (iv) a minimum of 45 hours successfully completed in upper-level courses. Other requirements vary by department.

At the graduate level, students may select marine-oriented research projects and course programs in pursuing the following degree programs.

1. Master of Science in Biology (one granted in 1978-1979).
2. Master of Science in Microbiology (one granted in 1978-1979).
3. Master of Science in Geology (two granted in 1978-1979).

General requirements for the above degrees include (i) a minimum of 30 graduate-level course hours, (ii) completion of an acceptable thesis (exceptions may be made in Geology), (iii) a minimum of 24 graduate-level hours completed in residence, and (iv) successful completion of comprehensive and final examinations. The student must also satisfy any specific department requirements for the degree to which he aspires.

The following are selected marine-related courses which are offered in conjunction with the above programs. Those numbered 500 or higher are available only to graduate students. Those undergraduate courses which are labeled "G" are also available for graduate credit.

UNDERGRADUATE COURSES

DEPARTMENT OF BIOLOGY

Biol. 323(G)	Invertebrate Zoology (and lab)	4
Biol. 351(G)	Parisitology (and lab)	4
Biol. 401(G)	Animal Ecology (and lab)	4
Biol. 408(G)	Animal Physiology (and lab)	4
Biol. 410	Individual Research	1-6
Biol. 420(G)	Scientific Cruise or Expedition	1-6
Biol. 422(G)	Aquatic Insects (and lab)	3
Biol. 423(G)	Field Marine Biology (and lab) (at field station)	5
Biol. 441(G)	Limnology (and lab)	4
Biol. 444(G)	Fish Propagation (and lab)	3
Biol. 445(G)	Ichthyology (and lab)	4
Biol. 447(G)	Fishery Science	3
Biol. 460(G)	Phycology (and lab)	4
Biol. 461(G)	Aquatic and Marsh Plants (and lab)	3
Biol. 481(G)	Introduction to Oceanography	3

DEPARTMENT OF MICROBIOLOGY

Mcbl. 451(G)	Marine Microbiology	3
Mcbl. 453(G)	Marine Microbiology Laboratory	1
Mcbl. 463(G)	Microbiological Problems I	1-6
Mcbl. 464(G)	Microbiological Problems II	1-6

DEPARTMENT OF GEOLOGY

Geol. 261	Invertebrate Paleontology I	3
Geol. 262	Invertebrate Paleontology II	3
Geol. 441(G)	Sedimentation (and lab)	3
Geol. 445(G)	Geology of the Gulf Coastal Plain	3

GRADUATE COURSES

DEPARTMENT OF BIOLOGY

Biol. 500	Quantative Ecology*	3
Biol. 523	Biology of the Arthropoda and Mollusca (and lab)	4
Biol. 545	Advanced Ichthyology (and lab)	4

*Semester scheduling varies with demand.

Biol. 560	Advanced Problems in Botany*	2-6
Biol. 561	Advanced Problems in Zoology*	2-6
Biol. 580	Marine Ecology	3
Biol. 599	Thesis Research and Thesis	1-6

DEPARTMENT OF MICROBIOLOGY

Mcbl. 505	Special Topics I	1
Mcbl. 506	Special Topics II	1
Mcbl. 521	Advanced Laboratory Methods	6
Mcbl. 563	Advanced Research Problems I*	2-6
Mcbl. 564	Advanced Research Problems II*	2-6
Mcbl. 599	Research and Thesis	1-6

DEPARTMENT OF GEOLOGY

Geol. 502	Advanced Sedimentation*	3
Geol. 503	Advanced Paleontology (and lab)*	3
Geol. 511	Special Problems*	1-3
Geol. 512	Special Problems*	1-3
Geol. 599	Thesis Research and Thesis	1-6

*Semester scheduling varies with demand.

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Dakin, Matt E., Ph.D., Professor
Ellington, W. Ross, Ph.D., Assistant Professor
Felder, Darryl L., Ph.D., Assistant Professor
Hackney, Courtney T., Ph.D., Assistant Professor
Hoese, H. Dickson, Ph.D., Professor
Konikoff, Mark A., Ph.D., Associate Professor
Pecora, Richard A., Ph.D., Associate Professor
Sullivan, Victoria I., Ph.D., Associate Professor

MICROBIOLOGY

Mathemeier, Paul F., Ph.D., Associate Professor

GEOLOGY

Kessinger, Walter P., Ph.D., Associate Professor
Lock, Brian E., Ph.D., Associate Professor
Paine, William R., Ph.D., Professor
Tucker, Daniel, Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. Richard A. Pecora, Chairman
Department of Biology, Box 42451
University of Southwestern Louisiana
Lafayette, Louisiana 70504

UNIVERSITY OF TEXAS
Austin, Texas 78712

Facilities for graduate work in Marine Studies are located primarily at the two Marine Science Institute Laboratories, at Port Aransas and Galveston. The Port Aransas Marine Laboratory is located on Aransas Pass Inlet near Corpus Christi, Texas. It occupies buildings among the dunes at the tip of Mustang Island, with easy access to bays, beaches, and the open Gulf. Environments readily accessible include the hypersaline Laguna Madre, oyster reefs, underwater grass flats, rock jetties, mud-bottom bays, beaches, and continental shelf.

The Port Aransas facility includes a library, classrooms, constant temperature growth chambers, sea water facilities, shops, and garages. A dock laboratory is on pilings over Aransas Pass. Twenty outdoor experimental ponds with filtered or raw sea water are available. The Laboratory provides a new air-conditioned 82-foot coastal research vessel, a 44-foot trawler, a 40-foot self-propelled barge, several smaller boats and related equipment, in addition to an assortment of vehicles for field use. Dormitory facilities are available. A recent expansion program has provided a new laboratory building with complete running sea water facilities for one-third of the floor space, a physical plant building, a dormitory, and an apartment complex.

The Galveston Geophysics Laboratory operates two ocean-going research vessels which are equipped with streamers and recording equipment for 48-channel seismic profiling. One of the vessels is equipped for deep ocean coring. Both have total field magnetometers, satellite navigation equipment, various echo sounding equipment and other geophysical instrumentation. The laboratory in Galveston is equipped with a Petty-Ray Tempus computer with an array processor for processing marine multichannel seismic data primarily from the Gulf of Mexico, the Caribbean, the Middle America Trench, and Atlantic continental margin of the U.S. Seismic data have been collected mainly on the continental slopes and deep ocean basins. All processed seismic sections are available on microfilm. The laboratory also has a small collection of sediment cores mainly from the Gulf of Mexico and the Middle America Trench.

Graduate degrees in Marine Sciences and in solid earth geophysics are offered through affiliation with the Department of Geological Sciences, University of Texas, Austin and the Geoscience program, University of Texas, Dallas, Ph.D. and M.A. degrees are offered. Course requirements are those set by the particular department. The general requirements are physically oriented, most students having a background in mathematics, physics, engineering, or geophysics. During the past year, two master's degrees and one doctorate have been awarded to students doing their research at the Galveston Geophysics Laboratory.

The following degrees are offered:

1. Master of Arts and Doctor of Philosophy programs in biological, physical or earth sciences may be concentrated in the area of marine science. Marine Science and related courses listed in the various Austin campus science departments may be used as supporting work for marine science programs.

2. M.A. in biological sciences (botany and zoology), chemistry, geology or microbiology with work concentrated in marine sciences. Nine to 12 hours of marine science as the minor may be combined with 12 to 15 hours of the major and six hours of thesis registration for a total of 30 hours. There is no language requirement for the master's degree in most of the related departments except geology. The program of study and the thesis are approved by a supervisory committee appointed by the dean.

3. Ph.D. in biological sciences (botany and zoology), chemistry, geology or microbiology with work concentrated in marine science. Requirements and examinations for admission to candidacy vary according to the specifications of the graduate faculty of the major department of Austin. German, French or Russian is generally used to fulfill the language requirement in most of the related science departments. There is no set number of course hours required. The program of study, languages, final oral examination and doctoral dissertation are approved by a supervisory committee and the dean.

During the past year, three M.A. degrees were granted in Biological Sciences, and one Ph.D. in Zoology to students doing their research at the Port Aransas Marine Laboratory.

Courses in marine studies are offered during the regular long session at the Austin campus. The Marine Science Institute offers regular summer courses and thesis research of special problem courses all year long at Port Aransas.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

MNS 307	Introduction to Oceanography
MNS 440	Limnology and Oceanography
MNS 148	Training Cruise
MNS 248	Training Cruise
MNS 348	Training Cruise
MNS 151	Seminar in Marine Studies
MNS 352	Principles of Marine Science
MNS 353	Topics in Marine Science
MNS 354	Marine Invertebrates
MNS 354E	Marine Microbial Ecology
MNS 354F	Marine Geology
MNS 354G	Biology of Microalgae
MNS 354K	Ecology of Fishes
MNS 354L	Marine Chemistry
MNS 354M	Structure and Function of Marine Animals
MNS 354N	Physical Oceanography
MNS 354P	Marine Meteorology
MNS 354R	Marine Ecosystems
MNS 354S	Environmental Physiology
MNS 354T	Biological Oceanography
MNS 367K	Oceanography: Man's Exploration and Exploitation of the Sea

DEPARTMENT OF CIVIL ENGINEERING

CE 358	Introductory Ocean Engineering	3
MET 376	Physical Oceanography	3

DEPARTMENT OF GEOGRAPHY

GRG 364	Oceanography	3

DEPARTMENT OF GEOLOGICAL SCIENCES

GEO 307	Introduction to Oceanography	3
GEO 367K	Oceanography	3
GEO 416M	Depositional Processes	4

DEPARTMENT OF ZOOLOGY

ZOO 332	Invertebrate Zoology	3
ZOO 369	Basic Ecology	3
ZOO 333	Vertebrate Biology	3
ZOO 361H	Comparative Animal Physiology	3
ZOO 440	Limnology and Oceanography	4

GRADUATE COURSES

MNS 680	Research in Marine Studies
MNS 382	Principles of Marine Studies
MNS 383	Topics in Marine Studies
MNS 384	Marine Invertebrates
MNS 384E	Marine Microbial Ecology
MNS 384F	Marine Geology
MNS 384G	Biology of the Microalgae
MNS 384K	Ecology of Fishes
MNS 384L	Marine Chemistry
MNS 384M	Structure and Function of Marine Animals
MNS 384N	Physical Oceanography
MNS 384P	Marine Meteorology
MNS 384R	Marine Ecosystems
MNS 384S	Environmental Physiology
MNS 384T	Biological Oceanography
MNS 384V	Principles and Practice of Aquaculture
MNS 188	Marine Research Training Cruise
MNS 288	Marine Research Training Cruise
MNS 388	Marine Research Training Cruise
MNS 389K	Physiological Phycology
MNS 191	Seminar in Marine Studies
MNS 391	Seminar in Marine Studies

DEPARTMENT OF BOTANY

BOT 389K	Physiological Phycology	3
BOT 492M	Marine Phycology	3

DEPARTMENT OF CIVIL ENGINEERING

CE 380P.1	Ocean Waves and Tides	3
CE 380P.2	Coastal Engineering	3
CE 380P.3	Estuarine Engineering	3
CE 380P.4	Functional Design of Coastal Structures	3
CE 385K.1	Stream, Impoundment and Estuarine Analysis I	3
CE 385K.2	Stream, Impoundment and Estuarine Analysis II	3

DEPARTMENT OF GEOLOGICAL SCIENCES

GEO 383	Depositional Systems: Terrigenous	3
GEO 383N	Biogenic and Evaporite Depositional Systems	3
GEO 391	Sedimentary Geochemistry	3

DEPARTMENT OF ZOOLOGY

ZOO 388L	Physiology of Marine Animals	3
ZOO 384L.4	Ichthyology	3

The instructional staff for the courses listed above consists of the following:

BOTANY

Van Baalen, C., Ph.D., Professor

CHEMISTRY

Parker, P.L., Ph.D., Professor

CIVIL ENGINEERING

Armstrong, Neal E., Ph.D., Professor
Holley, Edward, Ph.D., Professor
Mikead, Richard W., Ph.D., Associate Professor

GEOLOGICAL SCIENCES

Brown, L. Frank, Professor
Burtz, Robert H., Associate Professor
Land, Lynton S., Professor
McBride, Earle F., Professor
McGowen, Joseph H., Lecturer
Morton, Robert A., Lecturer
Scott, Alan J., Professor

GEOGRAPHY

Brand, D.D., Ph.D., Professor

MARINE STUDIES

Behrens, E. William, Ph.D., Associate Professor of Marine Studies
Cameron, James N., Ph.D., Associate Professor of Marine Studies
Dorman, H. James, Ph.D., Professor of Marine Studies
Goss, Wulf Achim, Ph.D., Assistant Professor of Marine Studies
Kitting, Christopher L., Ph.D., Assistant Professor of Marine Studies
Latham, Gary V., Ph.D., Professor of Marine Studies
Matumoto, Tosimatu, Ph.D., Professor or Marine Studies
Moore, J. Robert, Ph.D., Professor of Marine Studies
Nakamura, Yosio, Ph.D., Professor of Marine Studies
Nicol, J.A.C., Ph.D., Professor of Marine Studies
Oppenheimer, Carl H., Ph.D., Professor of Marine Studies
Parker, Patrick L., Ph.D., Professor of Marine Studies
Roels, Oswald A., Ph.D., Professor of Marine Studies
Van Baalen, Chase, Ph.D., Professor of Marine Studies
Wohlschlag, Donald E., Ph.D., Professor of Marine Studies

MICROBIOLOGY

Oppenheimer, C.H., Ph.D., Professor

ZOOLOGY

Bittner, G.D., Ph.D., Associate Professor
Cameron, James, Associate Professor
Hubbs, Clark, Ph.D., Professor
Kitting, Christopher, Assistant Professor
Larimer, James H., Professor
Maguire, Bassett, Jr., Ph.D., Associate Professor
Nicol, J.A.C., Ph.D., D.Sc., Professor
Wohlschlag, D.E., Ph.D., Professor

To obtain further information, address inquiries to:

The Graduate Advisor
Department of Marine Studies
The University of Texas at Austin
Box 7999, University Station
Austin, Texas 78712

COLLEGE OF ENGINEERING

The College of Engineering laboratories are well-equipped for ocean engineering research. Modern facilities and instrumentation are available for work in ocean hydrodynamics, structures, soils, saline water conversion, underwater acoustics and nuclear engineering. Numerous supporting laboratories are also available throughout the College.

The University offers the following degrees:

1. Master of Science in Engineering. The program leading to the degree of M.S. is not fixed but is developed in conferences between the student, the graduate faculty of the department in which the student elects to receive his degree, and a member of the ocean engineering committee. Administrative procedures are handled through the graduate advisor of the department. The M.S. degree requires at least 30 semester hours of work beyond the B.S. degree, six hours of which are usually for a thesis.

2. Doctor of Philosophy. The program leading to the degree of Ph.D. is developed by the student faculty advisor and approved by the departmental Committee on Graduate Studies. Students seeking this degree are expected to have well-developed ideas about their goals in graduate study and to a large extent the Ph.D. program accommodates the student's interests consistent with general requirements of the department and University.

Ocean engineering at the University of Texas at Austin is interdisciplinary and combines a basic knowledge of the ocean with engineering specialties for the utilization of the resources of the sea and its boundary. The program is based on a number of core courses with specific coastal and marine applications and supporting work with application to oceanic systems. Study in ocean engineering provides a balanced program including coursework, individual study and research. By electing courses from across departmental lines, individual programs can be set up in areas such as coastal and estuarine engineering, foundations and construction, structural engineering, mechanical and thermal systems, acoustics, communications and control systems, and ocean resources.

Courses in ocean engineering are offered during the regular year at the main campus by the Departments of Aerospace and Engineering Mechanics, Chemical, Civil, Electrical, Mechanical and Petroleum Engineering. Courses are also available at the University of Texas Institute of Marine Science at Port Aransas, Texas.

The following courses are offered in conjunction with the above program:

DEPARTMENT OF AEROSPACE ENGINEERING-ENGINEERING MECHANICS

ASE 382Q	Hydrodynamics

DEPARTMENT OF CIVIL ENGINEERING

UNDERGRADUATE COURSES

CE 358	Introductory Ocean Engineering
MET 376	Physical Oceanography

GRADUATE COURSES

CE 380P.1	Ocean Waves and Tides
CE 380P.2	Coastal Engineering
CE 380P.3	Estuarine Engineering
CE 380P.4	Functional Design of Coastal Structures
CE 385K.1	Stream, Impoundment and Estuarine Analysis I
CE 385K.2	Stream, Impoundment and Estuarine Analysis II
CE 394.1	Interaction of Soil and Structures - Selected Problems
CE 394.2	Interaction of Soils and Structures - Methods of Analysis
CE 397.52	Marine and Estuarine Pollution
CE 397.172	Marine and Water Transportation

DEPARTMENT OF ELECTRICAL ENGINEERING

UNDERGRADUATE COURSES

EE 379K.7	Tranducers

GRADUATE COURSES

EE 381J	Random Processes in Physical Systems
EE 384L.1	Waves in Material Media
EE 384L.2	Electrical Geophysics
EE 384N.1	Acoustics I
EE 384N.2	Acoustics II
EE 384N.3	Electromechanical Tranducers
EE 384N.4	Nonlinear Acoustics
EE 384N.5	Underwater Acoustics

DEPARTMENT OF MECHANICAL ENGINEERING

GRADUATE COURSES

ME 384N.5	Engineering Acoustics-Underwater Acoustics
ME 397	Similitude

DEPARTMENT OF PETROLEUM ENGINEERING

GRADUATE COURSES

PE 383.2	Advanced Well-logging and Correlation
PE 383.4	Offshore Drilling and Production Operations
PE 383.6	Rock Mechanics I
PE 383.8	Rock Mechanics II

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF AEROSPACE ENGINEERING AND ENGINEERING MECHANICS

Bertin, J.J., Ph.D., Professor
Mack, L.R., Ph.D., Associate Professor
Tapley, B.D., Ph.D., Professor

DEPARTMENT OF CHEMICAL ENGINEERING

Brock, J.R., Ph.D., Professor
Wissler, E.H., Ph.D., Professor

DEPARTMENT OF CIVIL ENGINEERING

Armstrong, N.E., Ph.D., Professor
Gloyna, E.F., Dr. Eng., Dean, Professor
Holley, Edward, Ph.D., Professor
Jehn, K.H., M.S., Professor
Koschmieder, E.L., Dr. Rer. Nat., Associate Professor
Malina, J.F., Ph.D., Professor and Chairman of Civil Engineering
Miksad, Richard W., Ph.D., Associate Professor
Moore, W.L., Ph.D., Professor
Reese, L.C., Ph.D., Professor
Roesset, Jose M., Ph.D., Professor
Stokoe, Kenneth H., Ph.D., Associate Professor
Wagner, N.K., Ph.D., Associate Professor
Walton, C.M., Ph.D., Associate Professor
Wright, S.G., Ph.D., Associate Professor
Yura, Joseph A., Ph.D., Professor

DEPARTMENT OF ELECTRICAL ENGINEERING

Bostick, F.W., Ph.D., Professor
Hixson, E.L., Ph.D., Professor
Smith, H.W., Ph.D., Professor

DEPARTMENT OF MECHANICAL ENGINEERING

Blackstock, D.T., Ph.D., Lecturer
Panton, R.L., Ph.D., Professor
Ferreira, N.D., Ph.D., Assistant Professor
Smith, C.C., Ph.D., Associate Professor

DEPARTMENT OF PETROLEUM ENGINEERING

Dorfman, Myron H., Ph.D., Professor and Chairman
Gray, K.E., Ph.D., Professor
Podio, A.L., Ph.D., Associate Professor
Thompson, T.W., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. Earnest F. Gloyna, Dean
College of Engineering
Cockrell Hall 10.310
University of Texas at Austin
Austin, Texas 78712

UNIVERSITY OF TEXAS MEDICAL BRANCH
THE MARINE BIOMEDICAL INSTITUTE
Galveston, Texas 77550

The Marine Biomedical Institute (MBI) is a component of The University of Texas Medical Branch at Galveston, Texas. The MBI has three Divisions. The Administrative and Comparative Neurobiology Divisions are housed in the Sealy-Smith Professional Building, which is adjacent to the Medical Branch campus, and the Marine Medicine Division occupies space in the same building and also in several buildings on the campus. The laboratories in the Sealy-Smith Building are dedicated to research activities and include an aquarium facility for maintenance of marine organisms, both invertebrate and vertebrate, and a variety of equipment for work in such fields as electrophysiology, biochemistry (including mass spectroscopy), transmission and scanning electron microscopy, and behavioral analysis. In League Hall are facilities for the maintenace of captured squid and for experimental work in squid mariculture. There is also a collection of preserved marine organisms caught in the Gulf of Mexico. A separate building contains a hyperbaric medicine facility, with a chamber for patients needing treatment with hyperbaric oxygen and also a laboratory for experimental work in diving physiology.

The MBI has two research vessels: the R/V Erin Leddy-Jones and the R/V Virginia Blocker. The R/V Erin Leddy-Jones is a 51-foot fiberglass stern trawler especially designed for collecting marine organisms close to the shore of the Gulf of Mexico. The R/V Virginia Blocker is a 41-foot Hatteras used particularly for collecting in the bay system and for explorations requiring diving. There are also smaller boats for diving operations and for estuarine work. The vessels are berthed at a dock belonging to The University of Texas adjacent to the Medical Branch.

The MBI is not involved in undergraduate education. However, members of the MBI belong to the faculty of the Medical Branch and the Graduate School of Biomedical Sciences, and so they participate actively in teaching the medical and graduate school curricula and in residency training. In addition, there is a substantial postdoctoral research training program. Ph.D. degrees are not offered through the MBI but rather through regular graduate programs in which members participate.

The staff and members of the MBI are:

ADMINISTRATIVE DIVISION

Burr, John L., Chief, Administrative Division
Johnson, Kenneth L., Chief, Facilities and Marine Operations
McClure, Gerald G., Supervisor, Hyperbaric Facility
Sikes, Robert D., Boat Captain
Suttle, Andrew D., Ph.D., Assistant to the Director for Physical Sciences
Willis, William D., Jr., M.D., Ph.D., Director

COMPARATIVE NEUROBIOLOGY

Blankenship, James E., Ph.D., Associate Professor of Physiology and Biophysics
Coggeshall, Richard E., M.D., Chief, Ultrastructure Section, Professor of Anatomy and of Physiology and Biophysics
Coulter, Joe D., Ph.D., Associate Professor of Physiology and Biophysics and of Psychiatry and Behavioral Science
Haber, Bernard, Ph.D., Chief, Neurochemistry Section, Associate Professor of Human Biological Chemistry and Genetics and of Neurology
Kittredge, James S., Ph.D., Chief, Comparative Marine Biochemistry and Pharmacology Section, Professor of Human Biological Chemistry and Genetics
Leonard, Robert B., Ph.D., Assistant Professor of Physiology and Biophysics
McAdoo, David J., Ph.D., Associate Professor of Human Biological Chemistry and Genetics
Pinsker, Harold M., Ph.D., Associate Professor of Psychiatry and Behavioral Science
Wong, Fulton, Ph.D., Assistant Professor of Physiology and Biophysics
Willis, William D., Jr., M.D., Ph.D., Chief, Comparative Neurobiology Section, Professor of Anatomy and of Physiology and Biophysics

MARINE MEDICINE

Hulet, William H., M.D., Ph.D., Chief, Marine Medicine Division, Professor of Internal Medicine and of Physiology and Biophysics
Mader, Jon T., M.D., Assistant Professor of Internal Medicine, Division of Infectious Diseases
Smith, David G., Ph.D., Instructor of Human Biological Chemistry and Genetics
Yang, Won Tack, Ph.D., Chief, Mariculture Research Section

To obtain further information, address inquiries to:

W.D. Willis, Jr., M.D., Ph.D.
Director
The Marine Biomedical Institute
200 University Boulevard
Galveston, Texas 77550

UNIVERSITY OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL SCIENCES
Charlottesville, Virginia 22903

The major facilities of the Department of Environmental Sciences are on the grounds of the University of Virginia, Charlottesville. These consist of a major building, Clark Hall, which houses classrooms, offices and laboratories, additional research laboratories in the Chemistry Building, and several semi-permanent field sites on the outer banks of North Carolina and the Virginia Barrier Islands.

The Office of the State Climatologist is housed with the department as are all of the historical climatological records of the Commonwealth. The department operates a fleet of small boats and a Cessna 207 equipped for remote sensing. In addition to modern analytical laboratories for environmental chemistry and biogeochemistry the department maintains a hydrodynamic and hydraulics laboratory and fresh water and marine aquaria systems.

The department offers a Bachelor of Arts which requires 30 hours of coursework consisting of the core courses EVSC 320, 340, 350 and 380 with their laboratories plus 14 additional hours within the department. In addition, calculus and biology, chemistry or physics are required. An undergraduate thesis is required for an honors degree.

At the graduate level the Master of Arts, Master of Science and the Doctor of Philosophy are offered. All graduate degrees require demonstrated proficiency of the undergraduate core courses and a thesis or dissertation. For the Master of Arts, 33 hours of coursework are required plus a library thesis. The Master of Science requires 24 hours of coursework and an original thesis. The coursework and foreign language requirements for the Ph.D. are established by the graduate student's individual committee.

During the last academic year the department granted 60 undergraduate degrees, 13 Masters and three Doctoral degrees.

The following marine-oriented courses are offered by the department. A substantial additional number of courses dealing with terrestrial environment is also offered.

UNDERGRADUATE COURSES

EVSC 210	Coastal and Fluvial Environments	3
EVSC 250	Man's Atmospheric Environment	3
EVSC 320	Fundamentals of Ecology	3
EVSC 340	Physical Hydrology	3
EVSC 350	Atmosphere and Weather	3
EVSC 380	Environmental Geology	3
EVSC 410	Survey of Geophysical Sciences	3
EVSC 415	Man and the Sea	3
EVSC 420	Environmental Chemistry: Measurement and Water Quality	3
EVSC 421	Population Ecology	3
EVSC 422	Applied Ecology	3
EVSC 423	Marine Environments and Organisms	3
EVSC 445	Synoptic Meteorology and Forecasting	3
EVSC 447	Applied Climatology	3
EVSC 450	Weather Forecasting Laboratory	1
EVSC 451	Synoptic Weather Laboratory	2
EVSC 485	Coastal Processes	3
EVSC 486	Chemistry of Natural Waters	3
EVSC 487	Holocene Environments	3
EVSC 488	Advanced Geomorphology	3

GRADUATE COURSES

EVSC 502	Environmental Measurements	4
EVSC 511	Systems Analysis in Environmental Sciences	4
EVEC 520	Aquatic Ecology	4
EVEC 523	Microbial Ecology	3
EVSC 540	Environmental Thermodynamics	4
EVAT 541	Planetary Fluid Motions	3
EVSC 542	Solar and Terrestrial Radiation	3
EVSC 572	Environmental Law and Policy	2
EVSC 584	Sediments and Sedimentary Fluid Dynamics	4
EVSC 710	Quantitative Methods in Environmental Sciences	3
EVEC 722	Estuarine Ecology	3
EVEC 724	Oceanic Ecology	4
EVAT 741	Dynamic Climatology	3
EVAT 742	Weather Modification	3
EVAT 743	Microclimate	3
EVHY 745	Estuarine Circulation	3
EVSC 782	Environmental Chemistry	4
EVGE 785	Marine Geology	3
EVSC 786	Isotope Geochemistry	3
EVHY 787	Coastal Hydrodynamics	3
EVHY 788	Aqueous Geochemistry	3
EVSC 792	Seminar in Marine Affairs	-
EVSC 795	Coastal Zone Management	3
EVEC 793	Fisheries Management	3
EVGE 793	Oceanography	3

To obtain further information, address inquiries to:

Dr. G.M. Hornberger
Chairman of the Department of
Environmental Sciences
Clark Hall
University of Virginia
Charlottesville, Virginia 22903
(804) 924-7761

GRADUATE SCHOOL OF ARTS AND SCIENCES

The Graduate School of Arts and Sciences also offers the Master of Arts in Marine Affairs. This is an interdisciplinary degree drawing on coursework in the College of Arts and Sciences, the Law School (Center for Oceans Law and Policy), the School of Architecture (Planning), and the School of Engineering. The degree requires 30 hours of coursework consisting of the following:

EVGE 793	Oceanography
GFAG 765	Economic Concepts and Public Policy
LAW4 657	Oceans Law and Policy
ECON 701	Price Theory

plus any two of the following:

EVEC 793	Fisheries Management
EVSC 795	Coastal Zone Management
EVSC 570	Natural Resource Utilization
EVSC 572	Environmental Public Policy

Twelve additional hours are required as prescribed by the student's committee from the following courses:

COLLEGE OF ARTS AND SCIENCES

Department of Economics

ECON 701	Price Theory
ECON 771	Elements of the Theory of Statistics
ECON 772	Econometrics
ECON 832	Seminar in Fiscal Theory
ECON 833	Seminar in Non-Market Transactions

Department of Environmental Sciences

EVGE 793	Oceanography
EVEC 793	Fisheries Management
EVGE 793	Coastal Processes
EVGE 785	Marine Geology
EVEC 724	Oceanic Ecology
EVEC 722	Estuarine Ecology

EVSC 570	Natural Resource Utilization
EVSC 764	Regional Development and Environmental Impact
EVSC 795	Coastal Zone Management
EVSC 572	Environmental Public Policy
EVSC 792	Seminar in Marine Affairs

Department of Government and Foreign Affairs

GFAG 760	Public Administration
GFAG 571	Public Policy Analysis: Economic and Political Approaches
GFAG 562	Organization Theory and Administrative Behavior
GFIR 511	Principles of International Law
GFAG 564	Politics, Policy, and Administration
GFIR 822	Topics in International Organizations
GFAG 765	Economic Concepts and Public Policy
GFAG 866	Policy Analysis

SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Systems Engineering

SYS 534	Systems Management for Research and Development
SYS 542	Planning, Policy and Decision Analysis
SYS 501	Introduction to Systems Engineering
SYS 551	Systems Analysis and Operations Research
SYS 566	Economic and Resource Analysis
SYS 752	Systems Analysis and Operations Research

SCHOOL OF ARCHITECTURE

Division of Urban and Environmental Planning

PLAN 809	Planning Theory and Practice
PLAN 551	Infrastructure for Environmental Planning

LAW SCHOOL

Oceans Law and Policy
Environment and the Law
Admiralty Law
Environmental Law
Ocean Resources Development
National Security Policy and the Oceans
Management of National Ocean Resources
Problems of the Law of the Sea

A thesis is required. Admission to the program is through the Faculty Advisory Committee on Marine Affairs.

To obtain further information, address inquiries to:

Dr. H.G. Goodell, Chairman
Committee on Marine Affairs
Department of Environmental Sciences
Clark Hall
University of Virginia
Charlottesville, Virginia 22903
(804) 924-7761

UNIVERSITY OF WASHINGTON
Seattle, Washington 98195

The University of Washington offers a variety of marine science-oriented programs using teaching and research facilities on its main campus and at several marine facilities in the Pacific Northwest and Alaska. Courses dealing with the ocean and its use to marine scientists are also offered in the Departments of Atmospheric Sciences, Economics, Geography, Geological Sciences, Geophysics, and in the College of Forest Resources. The University has established an Institute for Marine Studies to encourage interdisciplinary education and research programs, especially as they relate to policy and institutional problems of the oceans that combine natural sciences and engineering with law, economics, international affairs, and public administration. The Division of Marine Resources coordinates the Sea Grant Program, which involves courses related to marine resources taught in various departments and colleges.

The University also offers undergraduate and graduate programs in ocean engineering, fisheries, and law and marine affairs.

DEPARTMENT OF BOTANY

The Department of Botany's principal teaching and research facilities are located in Johnson Hall on the main campus and at Friday Harbor Laboratories. These include marine and freshwater algal culture facilities, numerous cultures of marine algae, a collection of preserved algae in a special algal herbarium, and scuba diving equipment. There are boats for field work and a larger vessel is available at the Friday Harbor Laboratories for dredging operations.

In addition to the Bachelor of Science degree program in botany, the department offers both a Master of Science and a Ph.D. degree program, with special emphasis in marine algology and marine mycology.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

445	Marine Botany (at Friday Harbor)	7
446	Algology	5
448	Marine Algal Ecology	3

GRADUATE COURSES

524	Topics in Algology	2
543	Freshwater Algae	5
545	Marine Algology (at Friday Harbor)	9
547	Phytoplankton Morphology and Taxonomy (at Friday Harbor)	7
549	Advanced Algology (at Friday Harbor)	9
565	Marine Mycology (at Friday Harbor)	9
569	Development in Lower Plants	5

The instructional staff for the courses listed above consists of the following:

Cattolico, Rose Ann, Ph.D., Assistant Professor
Norris, Richard, Ph.D., Professor

Waaland, Robert, Ph.D., Associate Professor
Waaland, Susan, Ph.D., Research Assistant Professor
Whisler, Howard, Ph.D., Professor

To obtain further information, address inquiries to:

Dr. L.C. Bliss, Chairman
Department of Botany
246 Johnson Hall, AJ-10
University of Washington
Seattle, Washington 98195

COLLEGE OF FISHERIES

The College of Fisheries is concerned in research and training with the investigation of possible ways to use stocks of fish and shellfish more effectively, how to make better use of all waters to produce more food from living organisms and how to culture aquatic plants and animals more effectively.

The College is also deeply concerned with the impact of pollution, of industry and of population pressure on the aquatic environment, both as these affect fisheries and also other uses of our waters. In general, the program of the College provides opportunity for training not only in fisheries, but in the management of natural resources and in the understanding and use of the aquatic environment.

Founded in 1919, the College of Fisheries has been intimately associated with the development and conservation of the fisheries of the northeastern Pacific Ocean. The College attempts to deal with the whole problem rather than with isolated technical questions, an approach which involves many phases of biology with particular emphasis on the quantitative aspects. Full attention is given to political, social, legal and economic problems associated with the use of resources. Although fishery problems of the Northwest are emphasized, they are examined as case histories, with many features applicable to problems of harvesting aquatic resources throughout the world and, as a result, many foreign students register in the College.

Since commercial fishing is so closely related to the food industry, the College maintains an Institute for Food Science and Technology to prepare food scientists in both industry and government. Both the graduate and undergraduate programs emphaize the role of the basic physical and biological sciences in the solution of problems which have resulted from the recent technological revolution in the food industry.

Although the Food Science program concentrates on general principles applicable to a wide range of food products, the extensive research programs are largely concerned with marine and freshwater products of the Pacific Northwest. The program attracts many out-of-state and foreign students, particularly at the graduate level.

The College of Fisheries field station at Big Beef Creek on Hood Canal provides additional opportunities for class field studies and research in stream and estuarine ecology. The food science facilities include separate well-equipped laboratories for food microbiology, food biochemistry and food analysis. A unique feature is the cobalt 60 research irradiator. A 67-foot diesel-powered boat, operated by the College, is capable of trawling to a depth of 1,000 fathoms and is equipped for other types of fishing as well as a wide variety of experimental work.

Basic requirements for admission to the graduate program in the College are a bachelor's degree from an institution of recognized standing with a grade point average of 3.00 in the junior and senior years of college work.

The following degrees are offered in the College of Fisheries:

1. Bachelor of Science and Bachelor of Science in Fisheries. Bachelor's degrees require completion of a common core curriculum in basic science (30 quarter credits), mathematics and statistics (9-11 quarter credits), environmental science (11 quarter credits), and social science (11 quarter credits). In addition to the core curriculum, the student selects one or two sets of prescribed courses from seven areas of emphasis. The sets consist of 25-30 quarter credits. The areas of emphasis are: fish culture, invertebrate culture, recreational fisheries, aquatic resource management, water quality, fish processing, and general environmental study.

2. Bachelor of Science (Food Science). To obtain this degree in the food science program, the student must complete the requirements for university graduation with at least 10 credits in humanities and biological studies. Courses in biochemistry, chemistry, mathematics, physics, preventive medicine and Fisheries 395 and Food Science 380, 481, 483, 484, 485, 486, 487 and 498 are required.

3. Master of Science. At least one year of approved study with a completion of a research project and thesis leads to the master's degree. A minimum of 45 upper-division or graduate credits must be presented including 18 credits in Fisheries 700 or Food Science 700, six credits in Fisheries 520 or Food Science 521 and three additional credits in courses numbered 500 or above.

4. Doctor of Philosophy. Students must complete at least three years of graduate study including a dissertation. Credits earned for a master's degree may be applied toward the doctor's degree. Students must demonstrate proficiency in translation of one foreign language.

The following courses are offered in conjunction with the above programs:

FISHERIES

101	Introduction to Fisheries Science	5
311	Functional Anatomy of Fish and Shellfish	4
314	Methods and Instruments for Fishery Investigations	3
340	Applications of Digital Computer to Biological Problems	4
352	Fundamentals in Fish Biochemistry	3
367	Recreational Fisheries	3
379	Fisheries of The World	3
395	Literature Search in Fisheries and Food Science	3
401	Classification of Economically Important Fishes	5
405	Economically Important Mollusca	5

406	Economically Important Crustacea	5
415	Principles of Fish Physiology	4
425	Life History of Marine Fishes	5
430	Biological Problems in Water Pollution	5
434	Ecological Effects of Waste Water	4
435	Physiological Effects of Water Pollutants	3
444	Fisheries Genetics	3
450	Salmonid Behavior and Life History	3
451	Reproduction of Salmonid Fishes	5
452	Nutrition and Care of Fishes	5
453	Salmonid Culture Technology and Production Management	4
454	Communicable Diseases of Fishes	5
455	Communicable Diseases of Fishes - Laboratory	2
456	Aquatic Entomology	5
457	Management of Exploited Animal Populations I	4
458	Management of Exploited Animal Populations II	4
459	Aquatic Food Chains	5
460	Water Management and Pollution Studies	5
461	Culture and Reproduction of Temperate and Warm Water Fishes	3
462	Methods of Stock Assessment	3
463	Principles of Resource Assessment	3
465	Marine Fish Biology	9
467	Fisheries Management	5
472	Aquatic Radioecology I	3
473	Aquatic Radioecology II	3
475	Marine Mammalogy and Conservation	5
477	Applied Chemical Techniques in the Aquatic Environment	3
499	Undergraduate Research	1-3, Max. 9
501	On-The-Job Training	1-3, Max. 3 for M.S.; 9 for Ph.D.
503	Systematic Ichthyology	5
504	Invertebrate Pathology	5
505	Research Techniques in Shellfish Biology	5
506	Shellfish Sanitation	5
507	Topics in Fish Ecology	1-5, Max. 15
515	Topics in Fish Physiology	3
516	Topics in Fish Physiology	2
520	Graduate Seminar	1
522	Graduate Seminar in Fisheries	1, Max. 2
525	Ecology of Marine Fishes	3
527	Aquatic Microcosms	5
535	Metabolic Effects of Chemical Pollutants	4
540	Application of Digital Computers to Problems in Aquatic Ecology	3
544	Genetics in Fish Management	3
556	Introduction to Quantitative Population Dynamics	3
557	Theoretical Models of Exploited Animal Populations	3
558	Estimation of Population Parameters	3
560	Methods of Stock Assessment	3
600	Independent Study or Research	Arranged
700	Master's Thesis	Arranged
800	Doctoral Dissertation	Arranged

FOOD SCIENCE

102	Food - The Technological Challenge	5
350	Food Components	3
378	Principles of Fishing Gear and Vessel Development	3
380	Principles of Fisheries Technology	3
381	Environment, Food and Technology	3
382	Food Technology for Dietitians	5
385	Food Engineering	3
390	Food Engineering I	4
417	Safety and Quality in Food Processing and Handling	4
481	Introduction to Food Technology	5
482	Principles of Food Analysis I	5
483	Principles of Food Analysis II	5
484	Principles of Food Processing I	5
485	Principles of Food Processing II	5
486	Deteriorative Processes in Foods	5
498	Undergraduate Thesis	2-6, Max. 6
504	Principles of Technological Research in Food	3, Max. 6
521	Graduate Seminar in Food Science	1, Max. 6
522	Biological and Chemical Origins of Foods and Food Components and Their Functional Characteristics	3
523	Advanced Marine Food Processes	5
524	Microorganisms in Foods	4
525	Advanced Unit Operations in Food Processing	3
526	Advanced Unit Operations in Food Processing Laboratory	3
600	Independent Study or Research	Arranged
700	Master's Thesis	Arranged

CENTER FOR QUANTITATIVE SCIENCE

281	Elementary Statistical Methods	5
290	Introduction to Mathematics for Biologists	4
291	Analysis for Biologists	3
292	Analysis for Biologists	3
340	Applications of Digital Computers to Problems in Resource Management	4
370	Operations Research in Resource Management	4
376	Operations Research in Resource Utilization I	3
381	Introduction to Probability and Statistics	5
382	Statistical Inference in Applied Research	5
383	Statistical Inference in Applied Research	5
391	Introduction to Matrices	3
450	Ecological Models	4
451	Ecosystem Dynamics	3
452	Ecosystem Dynamics	3
456	Mathematical Models in Population Biology	4
457	Management of Exploited Animal Population I	4
458	Management of Exploited Animal Population II	4
462	Irreversible Thermodynamics in Biology	4
471	Systems Analysis in Resource Management	4
476	Operations Research in Resource Utilization II	3
477	Advanced Mathematical Programming with Application in Resource Management	3
480	Sampling Theory for Biologists	4
486	Experimental Design	3
499	Undergraduate Research in Quantitative Ecology and Resource Management	1-5
502	Statistical Applications in the Biological Sciences	4

WILDLIFE SCIENCE IN FISHERIES AND FORESTRY

350	Wildlife Science	4
401	Biology and Conservation of Birds	5
402	Wildlife and Man	3
403	Wildlife and Land Use	3
404	Biology and Conservation of Mammals	5
450	Advanced Studies in Wildlife Ecology	3
475	Marine Mammalogy and Conservation	5

The instructional staff for the College of Fisheries is as follows:

Armstrong, David A., Ph.D., Assistant Professor
Bevan, Donald E., Ph.D., Professor
Brannon, Ernest L., Ph.D., Associate Professor

Brown, George W., Jr., Ph.D., Associate Professor
Burgner, Robert L., Ph.D., Professor and Director, Fisheries Research Institute
Chapman, Douglas G., Ph.D., Professor and Dean
Chew, Kenneth K., Ph.D., Professor
Conquest, Loveday L., Ph.D., Assistant Professor
DeLacy, Allan C., Ph.D., Professor (emeritus)
Donaldson, Lauren R., Ph.D., Professor (emeritus)
Fletcher, Richard Ian, Ph.D., Associate Professor
Gallucci, Vincent F., Ph.D., Assistant Professor
Gunderson, Donald R., Ph.D., Assistant Professor
Halver, John E., Ph.D., Professor
Hansen, Randall G., M.S., Lecturer
Hershberger, William K., Ph.D., Assistant Professor
Iwaoka, Wayne T., Ph.D., Assistant Professor
Landolt, Marsha L., Ph.D., Assistant Professor
Liston, John, Ph.D., Professor and Director, Institute for Food Science and Technology
Matches, Jack R., Ph.D., Professor
Mathews, Stephen B., Ph.D., Associate Professor
Mathisen, Ole A., Ph.D., Professor
Miller, Bruce S., Ph.D., Assistant Professor
Nakatani, Roy E., Ph.D., Professor and Associate Director, Fisheries Research Institute; Program Director, Living Research - Division of Marine Studies
Pauley, Gilbert B., Ph.D., Assistant Professor
Pietsch, Theodore W., Ph.D., Assistant Professor
Pigott, George M., Ph.D., Professor
Salo, Ernest O., Ph.D., Professor
Seymour, Allyn H., Ph.D., Professor and Director, Laboratory of Radiation Ecology
Smith, Lynwood, Ph.D., Professor
Taub, Frieda B., Ph.D., Professor
Van Cleve, Richard, Ph.D., Professor (emeritus)
Welander, Arthur D., Ph.D., Professor (emeritus)
Whitney, Richard R., Ph.D., Professor

To obtain further information, address inquiries to:

Dr. Douglas G. Chapman, Dean
College of Fisheries
University of Washington
Seattle, Washington 98105

LAW AND MARINE AFFAIRS

A program of graduate studies for the LL.M. degree.

For students who have completed the first degree in law, the School of Law at the University of Washington offers a course of study in law and marine affairs leading to the LL.M. degree. Particular emphasis is placed upon the interdisciplinary aspects of marine affairs. Curricular offerings are available in the School of Law, the Institute for Marine Studies, the Graduate School of Public Affairs, the College of Engineering, the Department of Economics, and the Department of Geography.

Requirements for conferral to the LL.M. degree include the satisfactory completion of 40 quarter credits of coursework and research, of which a minimum of 15 must be in the School of Law.

The following courses are offered in conjunction with the above programs:

CIVIL ENGINEERING

543	Marine Technology Affairs I	3
544	Marine Technology Affairs II	3

LAW

534	Law of the Coastal Zone	3
550	Admiralty	3
557	Law and Social Science Methods	2
574	Law, Public Land and Environment	3
584	International Legal Organization	3
586	International Legal Order	3
587	International Law of the Sea	3
624	Ocean Policy and Resources Seminar	2-2-2
579	U.S. Law for Living Marine Resources	3

MARINE STUDIES

500	Marine Affairs	5
503	The Ocean System	4
504	Marine Sciences and Uses of the Ocean	2
505	Marine Uses and Resources: Living Resources	3
507	International Organizations and Ocean Management	3
508	Economic Aspects of Marine Policy	3
509	Principles of Coastal Zone Management	3
511	Coastal Zone Management: Applying Environmental Information	3
512	Ocean Environment and Living Resources	3
517	Marine Uses: Transportation and Commerce	3
525	Ocean Law Enforcement	2
530	The Regional Implementation of an Extended Economic Zone	3
550	Special Topics in Marine Studies	1-3, Max. 18
571	Advanced Coastal Management Seminar	1-3, Max. 6
572	Advanced Coastal Management Seminar	1-3, Max. 6
573	Advanced Coastal Management Seminar	1-3, Max. 6
587	Marine Resource Management Seminar	3
588	Marine Resource Management Seminar	3
600	Independent Study or Research	2-2-2

PROGRAM IN OCEAN ENGINEERING

551	Ocean Engineering Systems Design I	3
552	Ocean Engineering Systems Design II	3

THE GRADUATE SCHOOL OF PUBLIC AFFAIRS

593	Policy Development and Administration: Natural Resources	3
594	Policy Development and Administration: Natural Resources	3

PROGRAM IN SOCIAL MANAGEMENT OF TECHNOLOGY

540	Social Management of Technology I	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF CIVIL ENGINEERING

Wenk, Edward, Jr., Ph.D., Professor of Engineering and Public Affairs

SCHOOL OF LAW

Burke, William T., LL.M., Professor, School of Law, Adjunct Professor, IMS
Johnson, Ralph W., LL.M., Professor, School of Law, Adjunct Professor, IMS

INSTITUTE FOR MARINE STUDIES

Alverson, Dayton L., Ph.D., Affiliate Professor, IMS; Affiliate Professor, College of Fisheries

Bevan, Donald E., Ph.D., Adjunct Professor, IMS; Professor, College of Fisheries; Assistant Vice President, Office of the Vice-President for Research

Burke, William T., LL.M., Adjunct Professor, IMS; Professor, School of Law

Crutchfield, James A., Jr., Ph.D., Adjunct Professor, IMS; Professor, Graduate School of Public Affairs; Adjunct Professor, Institute for Environmental Studies

Fleagle, Robert G., Ph.D., Adjunct Professor, IMS; Professor and Chairman, Department of Atmospheric Sciences

Fleming, Douglas K., Ph.D., Associate Professor, IMS; Associate Professor, Department of Geography

Fleming, Richard H., Ph.D., Professor of Marine Studies and Oceanography

Hershman, Marc J., J.D., Associate Professor, IMS and Division of Marine Resources; Adjunct Associate Professor, School of Law

Johnson, Ralph W., LL.M., Adjunct Professor, IMS; Professor, School of Law

McCulloh, Thane H., Ph.D., Affiliate Professor, IMS; Affiliate Professor, Department of Oceanography

McManus, Dean A., Ph.D., Adjunct Professor, IMS; Professor, Department of Oceanography

Miles, Edward L., Ph.D., Professor, IMS and Graduate School of Public Affairs; Adjunct Professor, Department of Political Science

Murphy, Stanley R., Ph.D., Adjunct Professor, IMS; Director, Division of Marine Resources; Professor, Departments of Oceanography, Mechanical and Ocean Engineering

Stokes, Robert L., Ph.D., Assistant Professor, IMS; Adjunct Assistant Professor, Department of Economics

Vesper, Karl H., Ph.D., Professor, IMS; Professor, Management and Organization and Mechanical Engineering

Wenk, Edward, Jr., Ph.D., Adjunct Professor, IMS; Professor, Engineering and Graduate School of Public Affairs

Wooster, Warren S., Ph.D., Professor, IMS and Fisheries; Adjunct Professor, Department of Oceanography

OCEAN ENGINEERING

Vesper, Karl, Jr., Ph.D., Professor, Management and Organization and Mechanical Engineering; Professor, IMS

PUBLIC POLICY

Burke, William T., LL.M., Professor, School of Law; Adjunct Professor, IMS

Crutchfield, James A., Jr., Ph.D., Professor, Graduate School of Public Affairs; Adjunct Professor, Institute for Environmental Studies and IMS

Marts, Marion E., Ph.D., Professor of Geography and Urban Planning; Adjunct Professor, Institute for Environmental Studies; Dean, Summer Quarter

Pealy, Robert H., Ph.D., Professor, Public Affairs; Director, Institute of Governmental Research

PROGRAM IN SOCIAL MANAGEMENT OF TECHNOLOGY

Wenk, Edward, Jr., Ph.D., Adjunct Professor, IMS; Professor, Engineering and Graduate School of Public Affairs

Persons interested in applying for the LL.M. program should do so early in the school year because the deadline for completed applications occurs in Spring Quarter. For information and application forms, write to:

Graduate Program Advisor
Law and Marine Affairs
University of Washington
School of Law, JB-20
Seattle, Washington 98195

OCEAN ENGINEERING PROGRAM

The Ocean Engineering Program at the University of Washington has been designed to take advantage of the breadth of marine and engineering-oriented curricula on campus and of the proximity of the campus to various marine environments. The undergraduate student may obtain a Bachelor of Science in Engineering degree through the Interdisciplinary Engineering Studies Program. Graduate students may enroll in a graduate degree program offered by the faculty of the engineering department that best fits their background and objectives, or may pursue a Master of Science degree through the Inter-Engineering Program. The program for the particular student is arranged on an individual basis and includes courses in the various engineering departments with related coursework in Oceanography, Fisheries, and the Institute for Marine Studies.

Laboratory facilities on campus and in the field are used to support teaching and research in ocean engineering. A large Chemical Engineering Laboratory with special facilities such as a 20-foot glass distillation column, a 20-foot absorption column, and a fluid (air and water) loop for research and calibration is available. Laboratories for hydraulics, wave studies, structures, materials, soil mechanics, water biology, and chemistry are located in Civil Engineering. Those for acoustics, electronics and control systems, and energy conversion are in Electrical Engineering. Mechanical Engineering has laboratories of heat transfer and thermodynamics, experimental stress analyses, material processing, and vibrations and acoustics. A ceramics laboratory and those for material properties and mineral processing are available through Mining, Metallurgy, and Ceramics. Nuclear Engineering has a separate teaching and research facility. Part of the work done by the Applied Physics Laboratory is marine-oriented and, when appropriate, a student's thesis research may be performed at this laboratory. A floating semi-submersible instrument platform is available for field research. The platform is designed to minimize wave excited motions and is instrumented with wave staffs and an anemometer. Data collection and processing are controlled by an onboard data aquisition system. Outstanding collections of books and periodicals of interest to the engineer and marine scientist and a research computer laboratory round out the facilities.

The following courses are offered in conjunction with the above programs:

AERONAUTICS AND ASTRONAUTICS

567	Analysis in Engineering I	3
568	Analysis in Engineering II	3
600	Independent Study or Research	Arranged
700	Master's Thesis	Arranged
800	Doctoral Dissertation	Arranged

CHEMICAL ENGINEERING

600	Independent Study or Research	Arranged
700	Master's Thesis	Arranged
800	Doctoral Dissertation	Arranged

CIVIL ENGINEERING

Core Courses

CIVE 506	Theory of Design	3
CIVE 599	Special Topics - Water and Air Resources	3
CIVE 600	Independent Study or Research	Arranged
CIVE 700	Master's Thesis	Arranged
CIVE 800	Doctoral Dissertation	Arranged

Structural Mechanics

CESM 573	Matrix Structural Analysis	3
CESM 574	Structural Dynamics	3
CESM 575	Variational Methods in Structural Mechanics	3
CESM 577	Finite Element Methods in Structural Mechanics	3

Transportation, Construction and Geometronics

CETC 523	Transportation Systems	3

Water and Air Resources

CEWA 542	Hydrodynamics I	[illegible]
CEWA 543	Hydrodynamics II	[illegible]
CEWA 558	Water Quality Management	3
CEWA 559	Water Resources System Management	3

ELECTRICAL ENGINEERING

421	Electroacoustics	4
505	Probability and Random Processes	4
518	Digital Signal Processing	4
519	Data Analysis	3
525	Acoustics in Engineering I	3
526	Acoustics in Engineering II	3
595	Advanced Topics in Communication Theory	3
600	Independent Study or Research	Arranged
700	Master's Thesis	Arranged
800	Doctoral Dissertation	Arranged

MECHANICAL ENGINEERING

406	Corrosion and Surface Treatment of Materials	3
470	Mechanical Vibrations	3
473	Instrumentation	3
564	Mechanical Engineering Analysis	3
565	Mechanical Engineering Analysis	3
589	Vibrations	3
590	Vibrations	3
600	Independent Study or Research	Arranged
700	Master's Thesis	Arranged
800	Doctoral Dissertation	Arranged

MINING, METALLURGICAL, AND CERAMIC ENGINEERING

CERE 600	Independent Study or Research	Arranged
CERE 700	Master's Thesis	Arranged
CERE 800	Doctoral Dissertation	Arranged
METE 423	Corrosion of Engineering Materials	3
METE 600	Independent Study or Research	Arranged
METE 700	Master's Thesis	Arranged
METE 800	Doctoral Dissertation	Arranged
MINE 426	Exploration and Development of Mineral Deposits	4
MINE 481	Mineral Industry Economics	4
MINE 600	Independent Research	Arranged

NUCLEAR ENGINEERING

486	Nuclear Power Plants	3
700	Master's Thesis	Arranged
800	Doctoral Dissertation	Arranged

OCEAN ENGINEERING

401	Introduction to Ocean Engineering	3
425	Underwater Acoustics	3
444	Coastal Engineering I	3
450	Marine Corrosion and Its Prevention	3
490	Naval Architecture	3
491	Naval Architecture	3
492	Naval Architecture	3
498	Special Topics in Ocean Engineering	1-5
503	Marine Technology Affairs I	3
504	Marine Technology Affairs II	3
541	Hydrodynamics in Water Quality	3
544	Coastal Hydraulics	3
580	Strain Measurements	3
590	Wind, Wave and Earthquake Response of Structures	3
599	Special Topics in Ocean Engineering	1-5

The instructional staff for the courses listed above includes the following:

DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS

Bollard, R.J.H., Ph.D., Professor of Aeronautics and Astronautics
Fyfe, Ian F., Ph.D., Professor of Aeronautics and Astronautics
Vagners, Juris, Ph.D., Associate Professor of Aeronautics and Astronautics and Applied Mathematics

DEPARTMENT OF CHEMICAL ENGINEERING

Gardner, Howard S., Sc.D., Professor of Chemical Engineering and of Pulp and Paper Technology
Moulton, R. Wells, Ph.D., Professor of Chemical Engineering

DEPARTMENT OF CIVIL ENGINEERING

Brown, Colin B., Ph.D., Professor of Civil Engineering

Hartz, Billy J., Ph.D., Professor of Civil Engineering
Hawkins, Neil M., Ph.D., Professor of Civil Engineering and Chairman
Mar, Brian W., Ph.D., Professor of Civil Engineering
Nece, Ronald E., Sc.D., Professor of Civil Engineering
Richey, Eugene P., P.D., Professor of Civil Engineering
Sherif, Mehmet A., Ph.D., Professor of Civil Engineering
Welch, Eugene B., Ph.D., Professor of Applied Biology in Civil Engineering
Wenk, Edward, Ph.D., Professor of Engineering and Public Affairs

DEPARTMENT OF ELECTRICAL ENGINEERING

Acker, William C., M.S.E.E., Lecturer, Electrical Engineering
Ehrenberg, John E., Ph.D., Research Associate Professor of Electrical Engineering
Lytle, Dean W., Ph.D., Professor of Electrical Engineering
Sigelmann, Rubens A., Ph.D., Associate Professor of Electrical Engineering
Swarm, H. Myron, Ph.D., Professor of Electrical Engineering

DEPARTMENT OF MECHANICAL ENGINEERING

Adee, Bruce H., Ph.D., Associate Professor of Mechanical Engineering
Calkins, Dale E., D.Eng., Research Associate Professor of Mechanical Engineering
Childs, Morris E., Ph.D., Professor and Chairman, Mechanical Engineering
Galle, Kurt R., Ph.D., Professor of Mechanical Engineering
Jorgensen, Jens E., Sc.D., Associate Professor of Mechanical Engineering
Merchant, Howard C., Ph.D., Professor of Mechanical Engineering
Murphy, Stanley R., Ph.D., Professor of Oceanography and Mechanical and Ocean Engineering
Storch, Richard L., Ph.D., Research Assistant Professor of Mechanical Engineering
Vesper, Karl H., Ph.D., Professor of Management and Organization and of Mechanical Engineering

DEPARTMENT OF MINING, METALLURGICAL AND CERAMIC ENGINEERING

Polonis, Douglas H., Ph.D., Professor and Chairman of Mining, Metallurgical and Ceramic Engineering

DEPARTMENT OF NUCLEAR ENGINEERING

Babb, Albert L., Ph.D., Professor and Chairman of Nuclear Engineering
Woodruff, Gene L., Ph.D., Professor of Nuclear Engineering

To obtain further information, address inquiries to:

Professor Bruce H. Adee, Director
Ocean Engineering Program, FU-10
326 Mechanical Engineering Building
University of Washington
Seattle, Washington 98195

DEPARTMENT OF OCEANOGRAPHY

The Department of Oceanography has laboratory and ship facilities located along the Lake Washington Ship Canal on the main campus. The department occupies three permanent buildings (two of which were constructed in 1967 and 1968). Research vessels ranging in size from 65 feet to 208 feet (the R/V Hoh, R/V Onar, R/V Kestrel, and R/V Thomas G. Thompson) are operated by the department for inshore and deep-sea studies.

Special facilities include a closed salt-water system, controlled environment room, a tidal model of Puget Sound, wave tanks and rotating models, shipboard and shore-based Prime 300 computers, a paleomagnetics laboratory, a sea-ice laboratory, a gas chromatograph x-ray emission and gammaray spectrometers, particle counters, provisions for work with radioactive isotopes, a chemostat laboratory, and a scuba support facility. Also available are an excellent Fisheries-Oceanography Library, a well-equipped developmental laboratory, and the University Computer Center. Departmental teaching and research also use the University's Friday Harbor Laboratories, a marine biological station on San Juan Island, about 80 miles north of the main campus.

The department offers the Bachelor of Arts and the Bachelor of Science degrees. The student in either curriculum must meet the requirements of the College of Arts and Sciences, outlined in the University bulletin.

Students who have majored in oceanography or another science and appear likely to succeed in graduate study can be accepted in the program of the Department of Oceanography. Admission is based on grade records, letters of recommendation, and the results of the Graduate Record Examination. Students who have not majored in oceanography, should acquire a broad background in science and mathematics equivalent to the requirements for the baccalaureate degrees in oceanography. Additional information can be obtained from the Graduate Program Office.

The student specializes in biological, chemical, geological, geophysical or physical oceanography; interdisciplinary studies are possible. All requirements of the Graduate School must be satisfied.

The department offers a thesis and a non-thesis program leading to the Master of Science degree. In both, the student and his or her advisor prepare a program of study to be approved by the student's supervisory committee. A departmental comprehensive written examination is required. Language requirement is determined by the student's faculty advisor.

The department also offers a program leading to the Doctor of Philosophy degree. The student and his supervisory committee prepare a program of study and research and the student must pass a general examination in oceanography and supporting fields. He then completes the research for his dissertation and prepares for his final examination.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

101	Survey of Oceanography	5
102	Man and the Ocean	3
110	Lectures in Oceanography	1

111	Lectures in Oceanography	1
112	Lectures in Oceanography	1
203	Introduction to Oceanography	5
341	Quantitative Methods in Oceanography I	3
342	Quantitative Methods in Oceanography II	3
401	General Physical Oceanography I	5
402	General Physical Oceanography II	5
405	General Geological Oceanography	6
406	Geological Oceanography Laboratory	2
415	Fundamentals of Underwater Acoustics	3
416	Applications of Underwater Acoustics	2
417	Physical Oceanography I	5
418	Physical Oceanography II	5
419	Ocean Tides and Waves	3
422	Theoretical Chemical Oceanography	3
423	Chemical Oceanography Laboratory	3
424	Chemical Oceanography Laboratory	2
433	General Biological Oceanography	5
434	Biological Oceanography: Phytoplankton	4
435	Biological Oceanography: Zooplankton and Nekton	3
436	Biological Oceanography: Benthic Communities	4
438	Marine Microbiology	3
439	Marine Microbiology Laboratory	2
440	Instruments in Oceanography	3-6
443	Regional Oceanography	3
444	Design and Analysis of Oceanographic Experiments	3
450	Geological Oceanography	4
451	Geochemistry of Marine Sediments	2
452	Physical Sedimentology	3
453	Sedimentary History of the Ocean Basin	2
454	Biogenic Sediments I	3
455	Biogenic Sediments II	3
456	Acoustic and Seismic Techniques	2
457	Marine Sedimentation	3
458	Chemical Aspects of Marine Sediments	3
460	Field Experience in Oceanography	2-5
475	Biogeography	3
499	Undergraduate Research	1-12

GRADUATE COURSES

500	Current Problems in Oceanography	1
511	Marine Hydrodynamics I	4
512	Marine Hydrodynamics II	4
513	Marine Hydrodynamics III	4
415	Seminar in Physical Oceanography	1
515	Waves	4
516	Ocean Circulation	4
517	Oceanography of Inshore Waters	5
518	Seminar in Dynamical Oceanography	1
519	Oceans and Climate Variations	3
520	Seminar	1
521	Seminar in Chemical Oceanography	Arranged
523	Advanced Problems in Chemical Oceanography	1-4
524	Marine Chemical Thermodynamics	3
525	Marine Chemical Dynamics	3
526	Marine Organic Geochemistry	2
530	Marine Primary Productivity	3
531	Seminar in Biological Oceanography	Arranged
533	Zooplankton Ecology	3 or 6
534	Phytoplankton Ecology	9
535	Advanced Plankton Ecology	2-4
536	Benthos Ecology	3
537	Environmental Physiology of Marine Microalgae	2-4
538	Identification and Structure of Marine Benthic Communities	2
540	Seminar in Geometronics	1-3
544	Statistical Models in Oceanography	3
548	Topics in Physical Oceanography	1-4
550	Seminar in Geological Oceanography	Arranged
551	Marine Sediments	2
553	Research Techniques in Marine Geochemistry	2
554	Research Techniques in Marine Geology	3
555	Marine Geochemistry	3
556	Advanced Marine Geology	Arranged
561	Seminar in Geological Fluid Mechanics	3
570	Simulation Analysis of Marine Systems	3
571	Gravity and Geomagnetic Interpretation	3
573	Terrestrial Magnetism	3
580	Marine Science for Management	3
600	Independent Study or Research	Arranged
700	Master's Thesis	Arranged
800	Doctoral Dissertation	Arranged

In addition to the course offerings leading to the degrees mentioned, courses dealing with the ocean and of use to marine scientists are offered in the Departments of Botany, Geophysics, Atmospheric Sciences, Zoology, the School of Business Administration, Geography, the College of Forest Resources, the Department of Economics and the School of Law. The Division of Marine Resources coordinates the Sea Grant Program, which involves courses related to marine resources, taught in various departments and colleges.

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF OCEANOGRAPHY

Aagaard, Knut, Ph.D., Research Professor
Ahmed, Saiyed I., Ph.D., Research Associate Professor
Anderson, George C., Ph.D., Professor and Associate Chairman for Research
Anderson, Jack W., Ph.D., Affiliate Associate Professor
Apel, John R., Ph.D., Affiliate Professor
Baker, D. James, Jr., Ph.D., Professor and Chairman
Baker, Edward T., Ph.D., Research Associate (Affiliate)
Banse, Karl, Ph.D., Professor
Barnes, Clifford A., Ph.D., Professor Emeritus
Burns, Robert E., Ph.D., Affiliate Associate Professor
Cannon, Glenn A., Ph.D., Affiliate Assistant Professor
Carpenter, Roy, Ph.D., Associate Professor
Christensen, Nikolas I., Ph.D., Adjunct Professor
Clarke, Allan, Ph.D., Research Associate
Cline, Joel D., Ph.D., Affiliate Assistant Professor
Coachman, Lawrence K., Ph.D., Professor
Creager, Joe S., Ph.D., Professor
Criminale, William O., Jr., Ph.D., Professor
Damkaer, David M., Ph.D., Affiliate Assistant Professor
Delaney, John R., Ph.D., Acting Assistant Professor
Duxbury, Alyn C., Ph.D., Research Associate Professor
Emerson, Steven R., Ph.D., Research Assistant Professor
English, T. Saunders, Ph.D., Associate Professor
Ewart, Terry E., Ph.D., Senior Research Associate
Feely, Richard A., Ph.D., Research Associate (Affiliate)
Fleming, Richard H., Ph.D., Professor
Frost, Bruce W., Ph.D., Associate Professor
Gait, Jerry A., Ph.D., Affiliate Assistant Professor

Germany, Jan, Ph.D., Research Associate
Gregg, Michael C., Ph.D., Research Associate Professor
Halpern, David, Ph.D., Affiliate Associate Professor
Hayes, Stanley P., Ph.D., Research Associate (Affiliate)
Hedges, John I., Ph.D., Research Assistant Professor
Henry, Dora P., Ph.D., Research Professor
Hickey, Barbara M., Ph.D., Research Assistant Professor
Holloway, Gregory, Ph.D., Research Assistant Professor
Holmes, Mark L., Ph.D., Research Associate (Affiliate)
Hood, Donald W., Ph.D., Senior Research Associate
Johnson, H. Paul, Ph.D., Research Assistant Professor
Jumars, Peter A., Ph.D., Assistant Professor
Kelley, James C., Ph.D., Affiliate Associate Professor
Landry, Michael, Ph.D., Research Assistant Professor
Larsen, Lawrence H., Ph.D., Research Associate Professor
Lewin, Joyce C., Ph.D., Research Professor
Lewis, Brian T.R., Ph.D., Associate Professor
Lister, Clive R.B., Ph.D., Professor
Lorenzen, Carl J., Ph.D., Research Associate Professor
Martin, Seelye, Ph.D., Research Associate Professor
McCulloh, Thane H., Ph.D., Affiliate Professor
McManus, Dean A., Ph.D., Professor and Chairman for Instruction
Merrill, Ronald T., Ph.D., Professor
Mofjeld, Harold O., Ph.D., Affiliate Assistant Professor
Murphy, Stanley R., Ph.D., Professor
Murray, James W., Ph.D., Assistant Professor
Nowell, Arthur R.M., Ph.D., Research Assistant Professor
Perry, Mary Jane, Ph.D., Research Assistant Professor
Rattray, Maurice, Jr., Ph.D., Professor
Richards, Francis A., Ph.D., Professor
Roden, Gunnar I., M.S., Senior Research Associate
Sanford, Thomas B., Ph.D., Research Professor
Schell, William R., Ph.D., Adjunct Associate Professor
Schoener, Amy, Ph.D., Research Assistant Professor
Smith, J. Dungan, Ph.D., Professor
Sternberg, Richard W., Ph.D., Professor
Stewart, Richard J., Ph.D., Adjunct Associate Professor
Taft, Bruce A., Ph.D., Research Associate Professor
Walsh, John J., Ph.D., Affiliate Assistant Professor
Wearn, Richard B., Ph.D., Research Associate
Welander, Pierre L.R., Ph.D., Professor
Whetten, John, Ph.D., Adjunct Professor
Winter, Donald F., Ph.D., Professor
Wooster, Warren S., Ph.D., Adjunct Professor

To obtain further information, address inquiries to:

Ms. Carolyn Hartness
Curriculum Advisor
108 Oceanography Teaching Building, WB-10
Department of Oceanography
University of Washington
Seattle, Washington 98195

INSTITUTE FOR MARINE STUDIES

The need for new approaches in education and research concerning marine policy arises from important recent developments at the national and international levels. These developments reflect an awakening public and private interest in the accelerating needs and technological capabilities of man to use and develop the ocean and coastal waters.

The Institute for Marine Studies is an academic and research unit at the University of Washington established to expand opportunities for more comprehensive and interrelated study and research of contemporary marine problems. The purpose of the Institute is to create and to foster innovative interdisciplinary courses of study and new approaches to marine policy research.

Twenty-eight faculty members representing the fields of oceanography, environmental studies, fisheries sciences, atmospheric sciences, engineering, marine law, economics, geography, political science and public policy are currently associated with the Institute.

The Institute offers a comprehensive academic program and graduate studies with emphases in the following areas: Coastal Zone Management, Marine Policy, and Marine Resource Management. Students with a particular interest in other areas of concentration (i.e., marine transportation and commerce, offshore technology systems) may under some circumstances be able to make special arrangements to pursue this interest as his/her area of concentration.

The programs are designed to meet the needs of students with varied academic backgrounds and different levels of education and experience. Individual programs will build upon a student's specialty and at the same time broaden his or her knowledge in those aspects of the social, technological and environmental sciences that deal with the ocean and its uses.

The Institute has developed a program of study leading to the Master of Marine Affairs (M.M.A.) degree. An approved thesis and 69 credits of coursework including nine credits of IMS 700 are required.

The following courses and seminars are offered through the Institute:

499	Undergrad Research	1-3
500	Marine Affairs	5
503	The Ocean System	4
504	Marine Sciences and the Uses of the Ocean	2
505	Marine Uses and Resources: Living Resources	3
506	International Law of the Sea	3
507	International Organizations and Ocean Management	3
508, 538	Economic Aspects of Marine Policy I, II	3, 3
509	Principles of Coastal Zone Management	3
510	Law of the Coastal Zone	3
511	Coastal Zone Management: Applying Environmental Information	3
512	Ocean Environment and Living Resources	3
517	Marine Uses: Transportation and Commerce	3
525	Ocean Law Enforcement	2

530	Regional Implementation of Extended Economic Zones	3
550	Special Topics in Marine Studies	1-3
551, 552	Ocean Engineering Systems Design I, II	3, 3
562-563	Ocean Policy Seminar	3-3
571-572-573	Advanced Coastal Management Seminar (Maximum of six credits)	Arranged
587-588	Research Seminar in Marine Resource Management	3-3
600	Independent Study or Research	Arranged
700	Master's Thesis	Arranged

The instructional staff for the courses listed above consists of the following:

Adee, Bruce H., Ph.D., Adjunct Associate Professor, IMS; Associate Professor, Mechanical Engineering; Director, Ocean Engineering Program
Alverson, Dayton L., Ph.D., Affiliate Professor, IMS; Affiliate Professor, College of Fisheries
Bevan, Donald E., Ph.D., Adjunct Professor, IMS; Professor and Acting Dean, College of Fisheries
Brewer, William A., Ph.D., Research Professor, IMS; Director, Washington Energy Research Center; Research Professor, Institute for Environmental Studies; Research Adjunct Professor, Civil Engineering
Burke, William T., LL.M., Professor, IMS; Professor, School of Law
Crutchfield, James A., Jr., Ph.D., Professor, IMS; Professor, Department of Economics and Graduate School of Public Affairs; Adjunct Professor, Institute for Environmental Studies
Duxbury, Alyn, Ph.D., Research Associate Professor, IMS; Research Associate Professor, Oceanography
Fleagle, Robert G., Ph.D., Adjunct Professor, IMS; Professor, Department of Atmospheric Sciences
Fleming, Douglas K., Ph.D., Associate Professor, IMS; Associate Professor, Department of Geology
Fleming, Richard H., Ph.D., Professor of IMS and Oceanography
Fluharty, David L., Ph.D., Research Associate, IMS
Gibbs, Stephen E., Ph.D., Research Associate, IMS
Hershman, Marc J., J.D., Associate Professor, IMS and Division of Marine Resources; Adjunct Associate Professor, School of Law
Johnson, Donald R., B.S., Affiliate Professor, IMS; Affiliate Professor, College of Fisheries
Johnson, Ralph W., LL.M., Adjunct Professor, IMS; Professor, School of Law
Kaczynski, Wlodzimierz M., Ph.D., Research Associate Professor, IMS and NORFISH; Associate Professor, Sea Fisheries Institute, Gdynia, Poland
Lee, Kai N., Ph.D., Adjunct Assistant Professor, IMS; Assistant Professor, Institute for Environmental Studies and Department of Political Science
Marasco, Richard, Ph.D., Affiliate Associate Professor, IMS
McCulloh, Thane H., Ph.D., Affiliate Professor, IMS; Affiliate Professor, Department of Oceanography
McManus, Dean A., Ph.D., Adjunct Professor, IMS; Professor, Department of Oceanography
Miles, Edward L., Ph.D., Professor, IMS and Graduate School of Public Affairs; Adjunct Professor, Department of Political Science
Miller, Marc, Ph.D., Research Assistant Professor, IMS
Murphy, Stanley R., Ph.D., Adjunct Professor, IMS; Director, Division of Marine Resources; Professor, Department of Oceanography and Mechanical and Ocean Engineering
Opheim, J. Eldon, B.A., Affiliate Professor, IMS
Stokes, Robert L., Ph.D., Assistant Professor, IMS; Adjunct Assistant Professor, Department of Economics
Vesper, Karl H., Ph.D., Professor, IMS, Management and Engineering, School of Business Administration and Mechanical Engineering
Wenk, Edward, Jr., Ph.D., Adjunct Professor, IMS; Professor, Engineering and Graduate School of Public Affairs; Director, Program in Social Management of Technology
Wooster, Warren S., Ph.D., Professor, IMS and Fisheries; Adjunct Professor, Department of Oceanography

To obtain further information, address inquiries to:

Graduate Program Advisor
Institute for Marine Studies, HA-35
University of Washington
Seattle, Washington 98195

DEPARTMENT OF ZOOLOGY

The Department of Zoology's offices and laboratories are in Kincaid Hall (opened December 1971) on the main campus with facilities for advanced instruction and research including controlled environment seawater aquarium rooms. The modern facilities of the Friday Harbor Laboratories on San Juan Island are also available for instruction and research on marine organisms.

While the department does not offer a degree in marine biology, students pursuing degree programs may strongly emphasize this area by selecting a variety of marine biology courses in fulfilling the degree requirements. Two undergraduate degree programs are offered: Bachelor of Arts and Bachelor of Science. Candidates for either must meet the requirements of the College of Arts and Sciences.

Graduate programs in the Department of Zoology including coursework and research lead to the Master of Science and Doctor of Philosophy degrees. A nonthesis master's program is also offered. The major fields of interest in the department are cellular and developmental biology, general and comparative physiology, ecology and ethology, and vertebrate and invertebrate zoology. A graduate student interested in marine biology may take several courses in the department or in one of a complex of departments of biological sciences at the university. Entering students should have completed the following courses: organic and/or physical chemistry, one year of college physics, mathematics through calculus, and a survey of the plant kingdom. Reading proficiency is required in at least one of the following languages: French, German, Japanese or Russian. All students are required to gain some teaching experience regardless of source of support. With the objective of insuring a broad background in zoology, an entering graduate student participates in a diagnostic conference with a faculty committee. The student's academic strengths and weaknesses are assessed in view of the student's interests and a course of studies is prescribed. A general oral examination taken in the third or fourth year includes the defense of an original research proposal and precedes candidacy for the Ph.D. degree.

The following marine-related courses are included in the Department of Zoology curriculum:

UNDERGRADUATE COURSES

330	Natural History of Marine Invertebrates	5
430	Marine Zoology	8
432	Marine Invertebrate Zoology	8
433	Invertebrate Zoology	5
434	Invertebrate Zoology	5
479	Environmental Physiology	5

GRADUATE COURSES

533	Advanced Invertebrate Zoology	6
534	Topics in Advanced Invertebrate Zoology	3
536	Comparative Invertebrate Embryology	6
538	Advanced Invertebrate Physiology	6
572	Topics in Ecology	2-3
574	Ecology of Marine Communities	3
575	Principles of Ecology as Applied to Fishes	3

The instructional staff for the courses listed above includes the following:

Cloney, Richard A., Ph.D., Professor
Fernald, Robert L., Ph.D., Professor
Illg, Paul L., Ph.D., Professor
Kohn, Alan J., Ph.D., Professor
Kozloff, Eugene N., Ph.D., Professor
Martin, Arthur W., Ph.D., Professor
Paine, Robert T., Ph.D., Professor
Strathmann, Richard, Ph.D., Assistant Professor
Whiteley, Arthur H., Ph.D., Professor
Willow, A.O. Dennis, Ph.D., Professor and Director, Friday Harbor Laboratories
Zaret, Thomas M., Ph.D., Research Assistant Professor

To obtain further information, address inquiries to:

Dr. Donald S. Farner, Chairman
Department of Zoology
106 Kincaid Hall, NJ-15
University of Washington
Seattle, Washington 98195

UNIVERSITY OF WEST FLORIDA
Pensacola, Florida 32504

This upper-division state university which opened in 1967 offers marine science-oriented courses on its 1,000 acre main campus located at the north end of Escambia Bay. The main focus for marine science affairs is the Department of Biology, housed in a new teaching and research facility. This facility has shops, equipment and wet rooms capable of managing more than 2,500 gallons of running sea water in closed systems. Through the cooperation of the Environmental Protection Agency, the University maintains a laboratory field station on Sabine Island in Santa Rosa Sound. The University has four 16-foot "whaler" type craft and the Argonaut, a 23-foot vessel equipped with fathometer, davit and winch. Through the Florida Institute of Oceanography, our students and faculty have opportunities for oceanographic studies in the Gulf of Mexico and Caribbean Sea.

The marine biology program is further supported by individual student research space and a variety of items of marine science equipment such as nets, seines, trawls, grabs and dredges, portable salinometers, oxygen meters, pH meters, current meters, transmissometer and gravity corer, sediment-sieves, scuba equipment and compressor. The laboratory facility has a complete suite of equipment for chemical oceanography.

The following degrees in marine sciences are offered by the University.

1. M.S. in Biology (Estuarine Biology). The Department of Biology offers graduate programs leading to the M.S. and M.S. in Teaching degrees. While the M.S. program is oriented to the study of estuarine systems, many other areas of biology are represented by the faculty and individually oriented investigations are encouraged. Applicants to either graduate program must hold a bachelor's degree in some field of biological science from an accredited institution. Applicants holding the bachelor's degree in a field other than biology will be considered for admission to either program by special request. The student must have a 3.0 average for the last 90 hours or a combined score of 1100 on the Graduate Record Examination.

In order to be advanced to candidacy for the M.S. or M.S. in Teaching degrees in biology, the student must meet certain requirements including obtaining a score of 70% or better on the advanced Graduate Record Examination (biology).

2. Master of Science. All candidates for the M.S. degree with thesis are required to complete a minimum of 45 quarter hours of approved credit. Of these, not less than 30 may be senior/graduate courses and not less than six nor more than ten quarter hours may be directed study or thesis. Fifty percent of the total hours must be graduate-level.

The matter of course selection is up to the student and his graduate advisory committee. If, upon review of the applicant's undergraduate record, a deficiency is noted by the student's graduate advisory committee, this deficiency must be remedied with a grade of "B" or better and without credit.

In addition to coursework, the student's program may require demonstration of a reading knowledge of scientific French, German or Russian. A written thesis and oral defense must be completed in a manner satisfactory to the student's graduate advisory committee.

Forty-eight M.S. degrees have been awarded since 1969.

3. B.S. in Biology (Marine Sciences). The prospective biologist or marine scientist should have a well-balanced general education in the humanities and social sciences. Consequently, the candidates for admission to the bachelor's degree program in biology at this university would be well prepared if they have completed the following courses: humanities (including English composition), social sciences, mathematics (through trigonometry), chemistry (through organic), physics (with laboratory) and biology.

General program requirements: A student graduating from study with the Department of Biology will receive a B.S. degree in biology when he or she has met the following departmental requirements: an average of greater than 2.0 in all biology subjects taken, completion of the assigned biology core courses with no grade less than a "C", and completion of at least two academic terms of general organic chemistry and a course in statistics.

In addition to the core, the student must select an additional 25 hours of seminar and coursework involving a marine orientation. At least five hours in botany must be included.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

BCH 3033	Biochemistry	5
BCH 3034	Biochemistry II	5
MCB 3020	Microbiology	5
OCE 3007	Introduction to Oceanography	5
PCB 3023	Cell Biology	5
PCB 3063	Genetics	5
PCB 3253	Developmental Biology	5
PCB 3673	Principles of Evolution	5
BOT 4643	Aquatic Botany	5
MCB 4654	Applied Microbiology	5
PCB 4033	General Ecology	5
PCB 4343	Field and Habitat Ecology	3
PCB 4723	Comparative Animal Physiology	5
ZOO 4254	Marine Invertebrate Zoology I	5
ZOO 4255	Marine Invertebrate Zoology II	5
ZOO 4304	Marine Vertebrate Zoology	5
ZOO 4513	Animal Behavior	3

SENIOR/GRADUATE COURSES

APB 5620	Scientific Illustration	3
BCH 5205	Intermediary Metabolism	5
BCH 5505	Enzymology	3
BOT 5405	Biology of Algae	5
BSC 5265	Biological Oceanography	5
BSC 5905	Directed Study	1-3
BSC 5930	Senior/Graduate Seminars	1-5
PCB 5176	Electron Microscopy	6
PCB 5305	Limnology	5
PCB 5479	Plankton Biology	5
PCB 5515	Advanced Genetics	5
PCB 5825	Endocrinology of Marine Organisms	5
ZOO 5816	Zoogeography	5

GRADUATE COURSES

APB 6706	Aquaculture	5
BCH 6646	Chemistry of Marine Natural Products	5
BSC 6905	Directed Study	Variable
BSC 6930	Graduate Seminars	1-5
MCB 6636	Aquatic Microbiology	5
PCB 6407	Ecological Adaptations	5
PCB 6526	Molecular Genetics	5
PCB 6606	Microbial Genetics	5
PCB 6727	Comparative Animal Physiology	5
ZOO 6266	Biology of Crustacea	5
ZOO 6276	Biology of Mollusca	5
ZOO 6456	Biology of Fishes	5
ZOO 6457	Reproductive Biology of Fishes	5

The instructional staff for the courses listed above consists of the following:

Baylis, J.R., Ph.D., Associate Professor
Bortone, S.A., Ph.D., Associate Professor
Bourquin, A.W., Ph.D., Faculty Associate
Butler, P.A., Ph.D., Faculty Associate
Chaet, A.B., Ph.D., Associate Vice President
Chang, C.W.J., Ph.D., Professor
Collard, S.B., Ph.D., Associate Professor
Couch, J.A., Ph.D., Faculty Associate
Cousens, M.I., Ph.D., Assistant Professor
D'Asaro, C.N., Ph.D., Professor
Duke, T.W., Ph.D., Faculty Associate
Hamilton, P.V., Ph.D., Assistant Professor
Hood, M.A., Ph.D., Associate Professor
Kiehl, B.L., Ph.D., Assistant Professor
Moshiri, G.A., Ph.D., Associate Professor
Rao, K.R., Ph.D., Professor
Riehm, J.P., Ph.D., Professor
Walsh, G.E., Ph.D., Faculty Associate
Winter, F.A., Ph.D., Associate Professor

To obtain further information, address inquiries to:

Chairman
Faculty of Biology
College of Arts and Sciences
The University of West Florida
Pensacola, Florida 32504

UNIVERSITY OF WISCONSIN-MADISON
Madison, Wisconsin 53706

Marine-related research at the University of Wisconsin has a history almost as long as that of the University itself. Nearly a century ago, E.A. Birge and Chancy Juday began a series of classic limnological studies resulting in fundamental contributions to plankton biology and the physics and chemistry of lakes. The multi-disciplinary nature of the Great Lakes and oceanographic research and education program at the University of Wisconsin-Madison is demonstrated by the participation of faculty and departmental resources throughout the campus.

The Marine Studies Center is the base of operations for the Oceanography and Limnology Program. Marine research at Wisconsin was given an additional boost in 1968 when the University of Wisconsin became one of the first of six universities to be designated as a Sea Grant Institution followed by designation as a Sea Grant College in 1972. Supported by the federal National Oceanic and Atmospheric Administration and the State of Wisconsin, the Sea Grant College program encompasses three areas of activity -- education, research and advisory services -- all focused on the utilization, conservation, and wise management of our marine and Great Lakes resources. The Sea Grant Program is organized into nine subprograms -- Living Resources, Aquaculture, Microcontaminants and Water Quality, Green Bay, Policy Studies, Geological and Mineral Resources, Diving Physiology, Ocean Engineering, and New Applications. Advisory Services and Education are separate but are inherently included in the research subprograms.

Research Facilities

Field studies are particularly important to marine and aquatic research and the University of Wisconsin owns and opetates several research vessels. The 41-foot *R/V Aquarius* is operated by the Sea Grant Institute and is based at Sturgeon Bay on Lake Michigan. The 62-foot *Neeskay* is operated on Lake Michigan by the Center for Great Lakes Studies at the University of Wisconsin-Milwaukee. Both these vessels are specifically outfitted for oceanographic survey work such as bottom coring, hydrographic casts, BT surveys, dredging and trawling, and chemical, physical, biological and meteorological observation. The 36-foot *R/V Salmo*, operated by the Geophysical and Polar Research Center (UW-Madison), is outfitted for bottom sampling, seismic reflection and refraction profiling, magnetometry, and resistivity measurements in the Great Lakes. University of Wisconsin-Madison scientists also use research vessels operated by the University of Michigan, the Environmental Protection Agency, vessels of the University National Oceanographic Laboratory (UNOLS) fleet, and Army, Navy and Coast Guard ships. The 30-foot *Limnos* is based on Lake Mendota at Madison. A Motorola Miniranger III navigation system is available. Specially outfitted pontoon boats and numerous smaller boats with outboards are available for lake study.

A number of coordinated ship-aircraft operations have been performed with the aid of research aircraft from the U.S. Navy, the Research Aviation Facility of the National Center for Atmospheric Research, the Wisconsin Department of Natural Resources and the Environmental Monitoring and Data Acquisition Group of the Institute for Environmental Studies.

Faculty and students have also routinely used vessels such as the *R/V Eastward* (Duke University) in the oceans.

The *Aquaculture Research and Demonstration Facility* is well-equipped for studying cool-water species; present research projects include fish nutrition, genetic selection for species improvement, reproductive physiology and engineering and economic aspects of perch production for food markets via aquaculture.

The University *Computer Center* houses a Univac 1110. Other computers readily available across campus include the Geophysical and Polar Research Center's Harris 6024/3, which is available for marine and limnological data analysis.

The *Geophysical and Polar Research Center* includes a scanning electron microscope, an electron probe, an extensive sediment pore fluid chemical analysis center, and a pool and associated facility for testing sonic devices. There are also portable instrument shelters for large ship programs on the Great Lakes and in the oceans. Additional computer and ship availability is listed above.

The Great Lakes Research Facility operated by the Milwaukee campus is available to graduate students on the Madison campus. It also offers a wide range of laboratory and field access facilities.

The *Hydraulics Laboratory* located on the engineering campus, has facilities for instruction and research including apparatus to measure liquid turbulence and conduct studies on Coriolis effects in scale models of lakes.

The University's main library reference facility, the Memorial Library, catalogues over two million volumes. The Kurt F. Wendt Engineering and Physical Sciences Library provides access to two computer terminals which allow direct entry into data bases at Lockheed in Palo Alto, California and the Argonne National Library in Oak Ridge, Tennessee. Both the Marine Studies Center and the Institute for Environmental Studies house reading and browsing collections, and there are departmental libraries in biology, earth science, life sciences, limnology and physical sciences.

The Laboratory of Limnology has facilities for the study of behavior and physiology of fishes, zooplankton, physical limnology and fishery biology as well as for paleo- and latitudinal-limnology, hydro-botany, microbiology and water chemistry. The Limnology Laboratory also maintains a year-round laboratory facility at Trout Lake. This facility is a well-equipped biological field station in the lake district in northern Wisconsin. A wide variety of lake types is available for study near the laboratory.

The Meteorology and Space Sciences Building houses physical oceanography laboratories as well as the offices of the Marine Studies Center.

The Water Chemistry Laboratory is situated on the shore of Lake Mendota in the Hydraulics Laboratory Building. Training and research in the Water Chemistry Program emphasize the chemical processes controlling the concentrations, chemical forms, and transformations of trace elements, nutrient elements, and organic compounds in natural waters and in water and waste-water treatment.

As utilization of marine resources expands, the social, political and legal implications of the use of the seas loom ever larger. The Marine Studies Center, mainly through the Sea Grant College Program, participates actively with political scientists, economists and lawyers who are jointly investigating these pressing problems of the sea.

The Oceanography and Limnology Graduate Program has been in existence at the University of Wisconsin-Madison since 1962. The interdepartmental program leading to the *M.S.* or *Ph.D. degree in Oceanography and Limnology* or a minor in this field is available, and provides graduate training in the marine sciences with a strong interdisciplinary flavor. Our program is based on the premise that oceanography and limnology considered together is an integrative field requiring a broad base in the fundamental disciplines plus specialization in the application of one particular discipline to the hydrosphere.

Entering students are expected to hold a degree in science, engineering or mathematics and to have had mathematics through integral calculus and one year each of college level biology, chemistry and physics. Study plans are individually tailored for each degree candidate. Students reside in the department in which they are specializing. A student in biological oceanography and limnology, for example, would reside in the departments of Bacteriology, Botany or Zoology. Students are expected to specialize and take courses in a particular aspect of oceanography and limnology: i.e., biological, chemical, geological/geophysical or physical.

The following degrees are offered:

1. Master's Degree in Oceanography and Limnology.

a) Five courses (two or more credits per course) must be selected from the following disciplines:

Biological Oceanography
Chemical Oceanography
Physical Oceanography and Engineering
Geological/Geophysical Oceanography

with at least three courses in one discipline and one course in each of two other disciplines. Additional credits will be advised by the major professor.

b) The Oceanography and Limnology Seminar must be taken at least once each year for credit.

c) A master's report or thesis.

d) An oral examination including defense of master's report or thesis by a three-person advisory committee including at least two professors from the Oceanography and Limnology Committee, one from the biological sciences division and one from the physical sciences division.

e) Field experience to be approved by the three-person advisory committee.

f) Two semesters of residence on campus.

2. Ph.D. Degree in Oceanography and Limnology.

The following minimum requirements for the Ph.D. degree apply to all candidates:

a) Residence: Each candidate must spend at least one continuous academic year in the major field beyond the master's degree level as a full-time graduate student, carrying a full load of graduate coursework or research and must devote one's self entirely to the graduate program.

b) Minor: A candidate is required to offer a minor field consisting of 10-12 credits representing a coherent body of work.

c) Thesis: The thesis must be the candidate's own work. It may be the result of research enterprises in which others have collaborated, but in such cases the candidate is required to present a substantial portion which represents the candidate's own contribution.

d) Final Oral Examination: The Dean of the Graduate School appoints for each candidate an examining committee of five or more members of the graduate faculty, with the major professor as chairman. The oral examination covers the thesis and the general field of the major and minor studies.

e) Core Curriculum: All Ph.D. candidates are required to complete the core curriculum requirements consisting of the following courses or their equivalent:

Geology 550 - Geological Oceanography	3 credits
Meteorology 460 - Physical Oceanography	3 credits
Civil and Environmental Engineering 514 - Coastal Engineering	3 credits
Civil and Environmental Engineering 502 - Marine Chemistry	2 credits
Zoology 518 - Hydrobiology	3 credits
Navigation, Ships and Charts	1 credit

f) All students must take the Oceanography and Limnology Seminar at least one semester per year until graduation. Ph.D. candidates are also required to take one additional seminar each year until their preliminary examinations.

g) The Ph.D. candidate must show competency in one foreign language which shall be determined by two years of college level coursework or by examination. The language must be approved by the student's committee.

3. Ph.D. Minor in Oceanography and Limnology.

Students working for a Ph.D. degree with a major in another department may elect to minor in Oceanography and Limnology. The minor program for each student is tailored individually and requires approval of the entire committee.

In addition, M.S. and Ph.D. degrees can be obtained in the traditional departments with strong aquatic programs, i.e., Bacteriology, Botany, Civil and Environmental Engineering, Geology and Geophysics, Meteorology and Zoology. For information write particular department or the O&L Graduate Program.

4. Master's Degree in Ocean Engineering.

Ocean engineering activities and their integrating line with the Oceanography and Limnology Program are coordinated by the Ocean Engineering Committee which consists of members from all engineering departments. An Ocean Engineering Master's Degree Program enables engineers to enter the field of oceanography and thereby apply their technical skills to this important area. For information write to:

Professor T. Green
Ocean Engineering Committee
College of Engineering
University of Wisconsin-Madison
Madison, Wisconsin 53706

5. Master's Degree in Water Resources Management.

This program is designed to prepare graduate students for employment in water resources management and planning activities. Through this program a student gains breadth within relevant management and planning areas while simultaneously developing depth within one of several area specialities. For information write:

(Please see next page)

Water Resources Management Program
University of Wisconsin-Madison
Room 72 Science Hall
550 N. Park Street
Madison, Wisconsin 53706
(608) 262-0651

Degrees granted: Master of Science: two; Ph.D.: three.

The following courses are offered in conjunction with the above programs:

AGRICULTURAL ECONOMICS

534	Water Resources Economics	3
744	Advanced Natural Resource Economics I	3
745	Advanced Natural Resource Economics II	3

BACTERIOLOGY

321	Laboratory in Environmental Microbiology	1
323	Environmental Microbiology	2-3
911	Oceanography and Limnology Seminar	1

BOTANY

260	Introduction to Ecology	3
300	Algae	3
460	General Ecology	4
911	Oceanography and Limnology Seminar	1

CIVIL AND ENVIRONMENTAL ENGINEERING

315	Hydrology	3
411	Open Channel Hydraulics	3
415	Water Resources Engineering	3
502	Marine Chemistry	2
511	Ocean Dynamics	2
512	Air-Sea Interaction	2
514	Coastal Engineering	3
516	Ocean Environment	1-4
518	Ocean Engineering Seminar	1
552	Remote Sensing of the Environment	3
611	Hydrodynamics	3
618	Special Topics in Hydraulics and Fluid Mechanics	1-3
711	Problems of Viscous Flow	2-3
712	Problems of Turbulent Flow	2-3
810	Problems in Oceanography	3
811	Theory of Water Waves	3
915	Seminar in Water Resources Planning I	2-3

ENTOMOLOGY

532	Aquatic Insects	4

FOOD SCIENCE

321	Regulatory and Quality Standards	1
322	Sanitation	1
330	Food Processing II - Tissue Systems	2
332	Food Processing III - Fluid and Semi Solid Systems	2
333	Food Processing Lab	2
699	Special Problems	Arranged
990	Research	Arranged

GEOLOGY AND GEOPHYSICS

550	Geological Oceanography	3
551	Recent Marine Sediments	3
553	Marine Geophysics	3
590	Geophysics, The Earth and Its Exploration	3
630	Physical Aspects of Sedimentation	2-3
732	Geochemistry of Sediments	3
740	Micropaleontology	3
750	Problems in Oceanography	3
790	Introduction to Wave Propagation	3
911	Oceanography and Limnology Seminar	1
977	Seminar in Sedimentology and Geological Oceanography	2

LAW

812	Admiralty Law	3
827	International Law	2-3
830	Local Government Law	3
845	Water Rights Law	2-3
846	Environmental Litigation	3
918	Selected Problems in International Law Seminar	2-3
919	International Organizations Seminar	2-3
937	Law, Technology and Society Seminar	2-3
988	Selected Problems in Environmental Law Seminar	2-3

MECHANICAL ENGINEERING

348	Mechanical Systems Analysis	3
491	Mechanical Engineering Projects I and II	3 ea.
748	Optimum Design of Mechnical Elements and Systems	3

METEOROLOGY

403	Micrometeorology	3
460	Physical Oceanography I	3
461	Physical Oceanography II	3
501	General Meteorology I	5
502	General Meteorology II	5
551	Geophysical Fluid Dynamics	3
662	Air-Sea Interaction I	2
663	Dynamical Oceanography II	2
750	Problems in Oceanography	3
861	Problems of Viscous Flow	2-3
862	Problems of Turbulent Flow	2-3
911	Oceanography and Limnology Seminar	1

POLITICAL SCIENCE

449	Government and Natural Resources	3
504	Science and Government	3
865	The Supreme Court and the Constitution in American Politics	3
965	Seminar: River Basin Planning	2-3
966	Seminar: Water Resources Planning	2-3

URBAN AND REGIONAL PLANNING

449	Government and Natural Resources	3
821	Resources Policy Issues: Regional and National	2-3
822	Resources Policy Issues: Regional and National	2-3
832-5	Regional Spatial Planning	2-3

843-2	Land Use Policy and Planning	3
865	Water Resources Institutions and Policies	3
965	Seminar in River Basin Planning	2-3
966	Seminar in Waster Resources Planning	2-3

WATER CHEMISTRY

500	Water Chemistry	3
501	Water Analysis - Intermediate	3
502	Marine Chemistry	2
516	Ocean Environment	1-4
609	Special Topics in Water Chemistry	Arranged
700	Advanced Water Chemistry	3
701	Advanced Techniques of Water Analysis	3
703	Organic Water Chemistry	2
810	Problems in Oceanography	3

ZOOLOGY

260	Introduction to Ecology	3
300	General Invertebrate Zoology	3
460	General Ecology	4
510	Ecology of Fishes	2
511	Ecology of Fishes Lab	2
515	Limnology - Conservation of Aquatic Resources	2
516	Limnology - Conservation of Aquatic Resources Lab	2
518	Hydrobiology	2
519	Hydrobiology Lab	2
532	Aquatic Insects	4
615	Biology of Aquatic Populations	3
750	Problems in Oceanography	3
911	Oceanography and Limnology Seminar	1

The instructional staff for the courses listed above consists of the following:

OCEANOGRAPHY AND LIMNOLOGY GRADUATE COMMITTEE

Andren, Anders W., Ph.D., Associate Professor of Water Chemistry
Armstrong, David E., Ph.D., Professor of Geology
Bowser, Carl J., Ph.D., Professor of Geology
Brock, Thomas D., Ph.D., Professor of Bacteriology
Calbert, Harold E., Ph.D., Professor of Food Science
Clay, Clarence, Ph.D., Professor of Geology
Graham, Linda K., Ph.D., Assistant Professor of Botany
Green, Theodore III, Ph.D., Professor of Civil and Environmental Engineering
Hasler, Arthur D., Ph.D., Emeritus Professor of Zoology
Hoopes, John A., Ph.D., Professor of Civil and Environmental Engineering
Kitchell, James F., Ph.D., Associate Professor of Zoology
Magnuson, John J., Ph.D., Professor of Zoology
Meyer, Robert P., Ph.D., Professor of Geophysics
Monkmeyer, Peter L., Ph.D., Professor of Civil and Environmental Engineering
Ragotzkie, Robert A., Ph.D., Professor of Meteorology
Steinhart, John S., Ph.D., Professor of Geology

DEPARTMENT OF AGRICULTURAL ECONOMICS

Bishop, Richard C., Ph.D., Assistant Professor
Bromley, Daniel W., Ph.D., Professor

DEPARTMENT OF BACTERIOLOGY

Brock, Thomas D., Ph.D., Professor
Harris, Robin F., Ph.D., Associate Professor
Zeikus, J.G., Ph.D., Associate Professor

DEPARTMENT OF BOTANY

Adams, Michael S., Ph.D., Associate Professor
Allen, Timothy Fran, Ph.D., Associate Professor
Cottam, Grant, Ph.D., Professor
Graham, Linda K., Ph.D., Assistant Professor

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Green, Theodore III, Ph.D., Professor
Hoopes, John A., Ph.D., Professor
Lenz, Arno J., Ph.D., Professor
Lettau, Heinz H., Ph.D., Increase A. Lapham Professor
Monkmeyer, Peter L., Ph.D., Professor
Villemonte, James R., Ph.D., Professor

DEPARTMENT OF ENTOMOLOGY

Boush, G. Mallory, Ph.D., Professor
Hillsenhoff, William L., Ph.D., Professor

DEPARTMENT OF FOOD SCIENCE

Amundson, C.H., Ph.D., Professor
Calbert, H.E., Ph.D., Professor
Marth, E.H., Ph.D., Professor
Stuiber, David, Ph.D., Professor
Von Elbe, J., Ph.D., Professor

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

Bowser, Carl J., Ph.D., Professor
Clay, Clarence S., Ph.D., Professor
Meyer, Robert P., Ph.D., Professor
Steinhart, John S., Ph.D., Professor

LAW

Bilder, Richard B., LL.B., Professor
Bunn, George, LL.B., Professor
MacDonald, James B., LL.B., Professor
Zile, Zigurds L., LL.B., Professor

DEPARTMENT OF MECHANICAL ENGINEERING

Harker, Ralph J., M.S., Professor
Koegel, Richard G., Ph.D., Associate Professor
Livermore, Donald F., Ph.D., Professor

DEPARTMENT OF METEOROLOGY

Bryson, Reid A., Ph.D., Professor
Green, Theodore III, Ph.D., Professor
Hastenrath, Stephan L., D.Sc., Professor

Lettau, Heinz H., Ph.D., Increase A. Lapham Professor
Ragotzkie, Robert A., Ph.D., Professor
Stearns, Charles R., Ph.D., Associate Professor
Young, John, Ph.D., Professor

DEPARTMENT OF POLITICAL SCIENCE

Emmerson, Donald K., Ph.D., Associate Professor

(Courses are also taught by John Steinhart, Department of Geology and Harold Jordahl, Jr., Department of Urban and Regional Planning.)

DEPARTMENT OF URBAN AND REGIONAL PLANNING

Amato, Peter W., Ph.D., Professor
Born, Stephen M., Ph.D., Associate Professor
Clarenbach, Fred A., Ph.D., Professor (Emeritus)
Jordahl, Harold C., Jr., M.S., Professor
Runge, Carlisle P., Ph.D., Professor

DEPARTMENT OF WATER CHEMISTRY

Anderson, Marc A., Ph.D., Assistant Professor
Andren, Anders W., Ph.D., Associate Professor
Armstrong, David E., Ph.D., Professor
Delfino, Joseph J., Ph.D., Associate Professor

DEPARTMENT OF ZOOLOGY

Dodson, Stanley I., Ph.D., Associate Professor
Fraser, Lemuel A., Ph.D., Professor
Hasler, Arthur Davis, Ph.D., Professor Emeritus
Kitchell, James F., Ph.D., Associate Professor
Magnuson, John J., Ph.D., Professor

To obtain further information, address inquiries to:

Professor John J. Magnuson, Chairman
Oceanography and Limnology Graduate Program
c/o Mrs. Charlotte Stein
Students Admissions Examiner
1225 West Dayton Street
University of Wisconsin-Madison
Madison, Wisconsin 53706
(608) 263-3264

UNIVERSITY OF WISCONSIN-MILWAUKEE
Milwaukee, Wisconsin 53201

Located at a major Lake Michigan port, UWM has developed substantial capabilities for instruction and research on the Great Lakes. In addition to the basic marine-related curriculum noted below, the emphasis here is on the hydrodynamics, biology, geology, and socio-technological management of the Great Lakes environment, now generally regarded as part of the nation's coastal zone.

An inter-departmental Center for Great Lakes Studies (CGLS) serves as a campus-wide coordinating focus for marine and related research, particularly at the graduate level. The Center's facilities include: a 65-foot research vessel, the R/V Neeskay; smaller vessels; machine and instrument shops; fish-rearing laboratories; and a wide range of specialized equipment for laboratory and field research in geophysical fluid dynamics, marine geology and geophysics, geochemistry, hydrobiology, environmental engineering, and marine transportation economics.

CGLS does not itself offer specific Lake- or marine-related undergraduate courses; these are taught by individual faculty members in their respective departments and colleges, as outlined below. The CGLS instructional role begins at the graduate level with seminars, training cruises, and above all, education through ongoing research. The establishment of CGLS in its present form in 1966 coincided with the decision to expand UWM into the second major doctoral university in what later became the statewide University of Wisconsin System. The CGLS vessel base and research activities are located at the UW Great Lakes Research Facility, a nine-acre site at 600 East Greenfield Avenue, Milwaukee, with 1,300 feet of deep-water dock on the harbor waterfront. The modern 125,000 square foot building was purchased from the Allen Bradley Company in 1973. At the present stage of remodelling (1979) with National Science Foundation and State support, one third of the space has been transformed into 17 specialized laboratories (including microbiological, sedimentological, ice-research, and fishery research complexes, and laboratories for aquatic chemistry, limnology, and marine engineering) and also general services to support vessel operations, instrument development, and data analysis.

The Facility not only houses CGLS; it also serves as a base of operations for some programs of the UW Sea Grant College, the Marine Studies Center in Madison, and other UW System Great Lakes related activities and provides a regional logistic base for the State and Federal agencies, as well as for other universities and individual investigators active in Great Lakes and aquatic research. In 1978 the Medical College of Wisconsin and UWM were jointly awarded a grant to establish one of the National Marine and Freshwater Biomedical Research Centers at the Facility.

Specifically designated degrees in marine sciences are not offered, but the following programs provide the opportunity for graduate students to specialize in Great Lakes- or marine-related fields. The numbers in parentheses indicate the number of marine-related and Great Lakes-related degrees awarded in those fields during the present academic year.

1. M.S. Programs in: Atmospheric Sciences (1); Botany (1); Engineering (1); Geography (1); Geological Sciences including Atmospheric Sciences (5); and Zoology (4).

In addition, two Ph.D. programs have recently been established:

2. Ph.D. in Biological Sciences (two Great Lakes-related degrees awarded in 1978-1979).

3. Ph.D. in Geosciences (starting this year).

Details of degree requirements can be obtained by writing to the Graduate School at the address given below.

A complete list of all basic and specialized courses offered in connection with the above programs would be too lengthy. Only specifically marine-related courses are included. For descriptions and timetables, those interested are invited to apply for the undergraduate or graduate bulletins.

UNDERGRADUATE COURSES

ATMOSPHERIC SCIENCES

190-100	Survey of Meteorology	4
190-350/1	Dynamic Meteorology I/II	3
190-511	Radiation	3
190-513	Turbulence and Boundary Layer Processes	3

BOTANY

208-110	Algae and Aquatic Problems	2
208-330	Morphology of Algae	3
208-430	Marine Algae	2

CIVIL ENGINEERING

240-310	Elements of Environmental Health	3
240-420	Environmental Health Engineering	3
240-521	Environmental-Sanitary Engineering Lab	3
240-610	Introduction to Water and Sewage Treatment	3

ENERGETICS

330-320	Introduction to Fluid Mechanics	2
330-420	Fluid Mechanics	3
330-628	Geophysical Fluid Dynamics I	3

GEOGRAPHY

416-432	Maritime Transportation	3
416-433	Economic Geography of the Great Lakes	3
416-411	Physical Climatology	3
416-456	Methods of Climatology	3

GEOLOGICAL SCIENCES

422-005	Anatomy of a Coral Reef	2
422-007	Wealth of the Sea	1
422-150	Introduction to Ocean Sciences	3
422-151	Ocean Sciences Lab	2
422-460	Oceanography	3
422-461	Oceanography Law	2
422-662	Geophysical Exploration: Marine Lab	1

MATERIALS

590-453	Marine Corrosion Engineering	3

ZOOLOGY

970-301	Invertebrate Zoology	4
970-516	Limnology Lecture	2
970-517	Limnology Lab	1
970-518	Fishery Biology	3
970-605	Concepts and Models in Limnology	2
970-611	Recent Advances in Limnology and Oceanography	2

GRADUATE COURSES

BIOLOGY

204-512	Marine Microbiology	2

ENERGETICS

330-721/1	Advanced Fluid Mechanics I/II	3, 3
330-729	Ocean Dynamics	3

GEOLOGICAL SCIENCES

422-734	Sedimentology	3
422-737	Marine Geology	3
422-961	Seminar in Sedimentology	3
422-973	Seminar in Geological Oceanography	3

ZOOLOGY

970-540	Marine Zoology	3
970-716	Lake and Ocean Dynamics	2
970-717	Field Methods and Problems in Great Lakes Research	2
970-929	Seminar: Aquatic Biology	2

The instructional staff for the courses listed above consists of the following:

ATMOSPHERIC SCIENCES

Johnson, R.H., Ph.D., Assistant Professor
Miller, D.H., Ph.D., Professor
Sikdar, D.N., Ph.D., Associate Professor

BOTANY

Blum, J.L., Ph.D., Professor
Salamun, P.J., Ph.D., Professor

CIVIL ENGINEERING

Christensen, E.R., Ph.D., Assistant Professor
Huang, J.Y.C., Ph.D., Assistant Professor
Lee, K.K., Ph.D., Professor

ENERGETICS

Lai, R.Y., Ph.D., Associate Professor

GEOGRAPHY

Bayer, K., RNDr, Associate Professor
Mayer, H.M., Ph.D., Professor

GEOLOGICAL SCIENCES

Cherkauer, D.S., Ph.D., Associate Professor
Kean, W.F., Ph.D., Assistant Professor
Lasca, N.P., Ph.D., Professor
Pincus, H.J., Ph.D., Professor
Taylor, R.W., Ph.D., Assistant Professor
Kaczorowski, R., Ph.D., Assistant Professor

ZOOLOGY

Brooks, A.S., Ph.D., Associate Professor
Coggins, J.R., Ph.D., Assistant Professor
Kaster, J.L., Ph.D., Assistant Professor
Mortimer, C.H., Ph.D., F.R.S., Distinguished Professor
Norden, C.R., Ph.D., Professor
Remsen, C.C., Ph.D., Associate Professor

To obtain further information, address inquiries to:

Dr. George W. Keulks, Dean
The Graduate School
University of Wisconsin-Milwaukee
P. O. Box 413
Milwaukee, Wisconsin 53201

THE VIRGINIA INSTITUTE OF MARINE SCIENCE
COLLEGE OF WILLIAM AND MARY
Gloucester Point, Virginia 23062

The major facilities of the Virginia Institute of Marine Sciences (VIMS) are at Gloucester Point, on the York River across from Yorktown. A branch laboratory at Wachapreague on the ocean side of the eastern shore of Virginia is primarily concerned with the development of techniques for the aquaculture of hard clams and bay scallops.

The Gloucester Point facility consists of several permanent buildings on a 35 acre site. Matthew Fontaine Maury Hall houses the Institute's Director's office, an exhibit hall, and a marine science library. The newest and largest building, Richard Evelyn Byrd Hall, has laboratory and office space for various ecology-pollution programs, the environmental physiology laboratory and the institute's computer center and classrooms. A demonstration aquaculture and shellfish depuration laboratory is under construction. Other buildings are used for offices, laboratories and shops. The field station at Wachapreague includes a dormitory for 30 students and four instructors complete with kitchen, bathroom, laboratory and classroom space. All laboratories are in use year-round. Excellent reference collections of fishes and invertebrates are available. A worldwide collection of fish parasites is of particular interest.

VIMS operates an extensive fleet of research vessels. These include the 144-foot ocean going R/V Virginian Sea, capable of extended operations at sea. Her equipment includes radar, Loran "C", radios, a fathometer, three laboratories and a full suite of fishing and oceanographic winches. Other well-equipped vessels include the Retriever (110 feet), Tern (85 feet), Langley (80 feet), Pathfinder (57 feet), and numerous smaller vessels.

The Institute has an extensive list of modern scientific equipment including a mass spectrometer, two electron microscopes (both scanning and transmission) and a sophisticated electronic computing center. Also on campus are a marine science library containing approximately 25,000 volumes and 1,500 serial titles, as well as hydraulic flume and a ripple tank. These as well as a hydraulic model of the James River located at Vicksburg, Mississippi are available for research by qualified students.

VIMS offers the degrees of Master of Arts and Doctor of Philosophy in Marine Science at the School of Marine Science, College of William and Mary, Williamsburg, Virginia. The great majority of the courses included are taught at Glouscester Point by VIMS scientists so that students seldom need to visit the campus at Williamsburg. Some elective courses are offered at William and Mary.

Majors in Biological Oceanography (Marine Biology), General Oceanography (Physical, Chemical or Geological areas), Fisheries Oceanography (Marine Fisheries Biology), and Marine Affairs are available at both levels. Within these general areas, study of several specialties may be undertaken -- for example, Marine Pollution Biology, Wetlands Ecology, etc. Though the courses offered by the School are primarily for graduate students, advanced undergraduates (juniors and seniors) may participate.

The following degrees are offered:

1. M.A. in Marine Science. Requirements: at least 30 semester credits advanced work, including six for M.S. 560 (thesis), a minimum residence period of one calendar year, presentation of a thesis, at least six semester hours of one pertinent foreign language or satisfactory performance on an approved foreign language examination (German, French or Russian is usually recommended), and satisfactory performance on a comprehensive examination.

2. Ph.D. in Marine Science. Requirements: a minimum of three years of graduate study beyond the baccalaureate (at least one academic year beyond the first must be spent in continuous residence as a full-time student), course requirements at the discretion of the school, completion and defense of a dissertation, reading knowledge of two approved foreign languages, and a comprehensive examination.

During the 1977-1978 academic year, VIMS granted five master's and five doctoral degrees.

The following courses are offered in conjunction with the above programs:

501	Introduction to Physical Oceanography	3
502	Introduction to Chemical Oceanography	3
503	Introduction to Biological Oceanography	3
504	Introduction to Geological Oceanography	3
505	Problems in Marine Science	1-4
506	Introduction to Marine Science	3
507	Statistics for Marine Scientists I	3
508	Computer Programming for Marine Scientists I	1
509	Computer Programming for Marine Scientists II	1
510	Marine and Freshwater Invertebrates	5
512	Marine Botany	5
513	Coastal Botany	3
519	Computer Applications in Marine Science	1
520	Literature Search and Scientific Writing	1
560	Thesis	Variable
601	Marine Science Seminar	1-3
602	Advanced Biological Oceanography	3
603	Advanced Problems in Marine Science	1-4
604	Biology of Selected Marine Invertebrates	3

605	Radiobiology	4
606	Fisheries Oceanography	3
607	Marine Microbiology	5
608	Ichthyology	5
609	Oceanographic Instrumentation	1
610	Pollution Biology	3
611	Advanced Analytical Methods for Water Quality Studies	1
612	Parasites of Marine Organisms	5
613	Marine Biogeography	3
614	Coastal Processes	3
615	Embryology of Marine Invertebrates	5
616	Dynamics of Coastal Geomorphology	3
617	Engineering Structures and Environmental Effects	3
618	Marine Fishery Science	4
619	Statistics for Marine Scientists II	3
620	Environmental Physiology	3
621	Chemical Oceanography	3
622	Environmental Physiology Laboratory	3
623	Topics in Applied Marine Science	1-4
624	Physiology of Marine Organisms	5
625	Hydromechanics	3
626	Geophysical Fluid Dynamics	3
627	Advanced Physical Oceanography	3
628	Micrometeorology and Hydrology of the Coastal Zone	3
629	Introduction to Sediment Transport	2
630	The Early Life History of Marine Fishes	4
631	Estuary and Shallow Water Hydrodynamics I	3
632	Estuary and Shallow Water Hydrodynamics II	3
633	Remote Sensing of Environment	3
640	Population Dynamics	4
641	Advanced Techniques in Statistical Analysis	Variable
644	Marine Mycology	4
645	Marine Phytoplankton	3
646	Marine Zooplankton	3
647	Marine Benthos	3
648	Marine Protozoology	4
649	Marine Resources in Public Affairs	2
650	Environmental Law and Marine Affairs I	1-4
651	Natural History of the Chesapeake Bay -- Physical	3
652	Practical Application of Marine Resource Management Techniques	1-4
660	Dissertation	Variable

The instructional staff for the courses listed above consists of the following:

Andrews, Jay Donald, Ph.D., Professor of Marine Science
Bender, Michael E., Ph.D., Professor of Marine Science
Black, Robert E.L., Ph.D., Professor of Biology and Marine Science
Byrne, Robert J., Ph.D., Professor of Marine Science
Fang, Ching Seng, Ph.D., Professor of Marine Science
Hargis, William J., Jr., Ph.D., Dean and Professor of Marine Science
Haven, Dexter S., M.S., Professor of Marine Science
Lynch, Maurice P., Ph.D., Professor of Marine Science
Nichols, Maynard M., Ph.D., Professor of Marine Science
Perkins, Frank O., Ph.D., Professor of Marine Science
Van Engel, Willard A., Ph.D., Professor of Marine Science
Webb, Kennth L., Ph.D., Professor of Marine Science
Zeigler, John M., Ph.D., Professor of Marine Science
Austin, Herbert M., Ph.D., Associate Professor of Marine Science
Bieri, Rudolph H., Ph.D., Associate Professor of Marine Science
Boesch, Donald F., Ph.D., Associate Professor of Marine Science
Boon, John D., III, Ph.D., Associate Professor of Marine Science
Castagna, Michael, M.S., Associate Professor of Marine Science
Dupaul, William D., Ph.D., Associate Professor of Marine Science
Evans, David A., Ph.D., Associate Professor of Marine Science
Goldsmith, Victor, Ph.D., Associate Professor of Marine Science
Grant, George C., Ph.D., Associate Professor of Marine Science
Huggett, Robert J., Ph.D., Associate Professor of Marine Science
Kuo, Albert Y., Ph.D., Associate Professor of Marine Science
Loesch, Joseph G., Ph.D., Associate Professor of Marine Science
MacIntyre, William G., Ph.D., Associate Professor of Marine Science
Merriner, John V., Ph.D., Associate Professor of Marine Science
Munday, John C., Ph.D., Associate Professor of Marine Science
Musick, John A., Ph.D., Associate Professor of Marine Science
Neilson, Bruce J., Ph.D., Associate Professor of Marine Science
Roberts, Morris H., Jr., Ph.D., Associate Professor of Marine Science
Silberhorn, Gene M., Ph.D., Associate Professor of Marine Science
Smith, Craig L., Ph.D., Associate Professor of Marine Science
Theberge, N. Bartlett, Jr., LL.M., Associate Professor of Marine Science
Wass, Marvin L., Ph.D., Associate Professor of Marine Science
Welch, Christopher S., Ph.D., Associate Professor of Marine Science
Zubkoff, Paul L., Ph.D., Associate Professor of Marine Science
Boehlert, George W., Ph.D., Assistant Professor of Marine Science
Burreson, Eugene M., Ph.D., Assistant Professor of Marine Science
Chen, Hsuan Shan, Ph.D., Assistant Professor of Marine Science
Cueman, Michael K., Ph.D., Assistant Professor of Marine Science
Diaz, Robert J., Ph.D., Assistant Professor of Marine Science
Dupuy, John L., Ph.D., Assistant Professor of Marine Science
Haas, Leonard W., Ph.D., Assistant Professor of Marine Science
Harris, Richard L., Ph.D., Assistant Professor of Marine Science
Ho, Gaines Chen-Sang, Ph.D., Assistant Professor of Marine Science
Hobbs, Carl H., III, M.S., Assistant Professor Marine Science
Hyer, Paul V., Ph.D., Assistant Professor of Marine Science
Jordan, Robert A., Ph.D., Assistant Professor of Marine Science
Kator, Howard, Ph.D., Assistant Professor of Marine Science
Kraeuter, John N., Ph.D., Assistant Professor of Marine Science

Orth, Robert J., Ph.D., Assistant Professor of Marine Science
Penhale, Polly A., Ph.D., Assistant Professor of Marine Science
Roller, William F., Ph.D., Assistant Professor of Marine Science
Ruddell, Craig L., Ph.D., Assistant Professor of Marine Science
Ruzecki, Evon Paul, Ph.D., Assistant Professor of Marine Science
Serafy, D. Keith, Ph.D., Assistant Professor of Marine Science
Su, Chih-Wu, Ph.D., Assistant Professor of Marine Science
Wardle, William J., Ph.D., Assistant Professor of Marine Science
Warinner, J. Ernest, III, M.A., Assistant Professor of Marine Science
Wetzel, Richard L., Ph.D., Assistant Professor of Marine Science
Wojcik, Frank J., M.S., Assistant Professor of Marine Science
Barnard, Thomas A., Jr., M.A., Instructor in Marine Science
Bosco, Cynthia L., M.A., Instructor in Marine Science
Cerco, Carl F., M.S., Instructor in Marine Science
Cornell, Elizabeth A., M.S., Instructor in Marine Science
Dawes, George M., B.A., Instructor in Marine Science
Gordon, Hayden H., M.S., Instructor in Marine Science
Hershner, Carl, Ph.D., Instructor in Marine Science
Jones, J. Claiborne, M.A., Instructor in Marine Science
Kilch, Linda R., M.S., Instructor in Marine Science
Lanier, James A., III, M.A., Instructor in Marine Science
Lucy, Jon A., M.A., Instructor in Marine Science
Lukens, Robert J., B.S., Instructor in Marine Science
Olney, John E., M.A., Instructor in Marine Science
Pleasants, John B., M.M.A., Instructor in Marine Science
Schmied, Ronald L., M.S., Instructor in Marine Science
Shaw, Ginny H., M.S., Instructor in Marine Science
Sulak, Kenneth J., M.S., Instructor in Marine Science
Zwerner, David E., M.A., Instructor in Marine Science

To obtain further information, address inquiries to:

Dr. William J. Hargis, Jr.
Director
Virginia Institute of Marine Science
Glouscester Point, Virginia 23062

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

Virginia Polytechnic Institute and State University has research and teaching facilities located on the main campus in Blacksburg and has a small marine laboratory in Hampton, Virginia.

Major campus research facilities in fisheries include seven laboratories and a cold storage room in Cheatham Hall, as well as a large equipment storage building and a fish culture building. In ocean engineering, research facilities include a towing tank for ship and submarine hydrodynamic studies, a cavitation tank, or rotating ocean flow basin, a large, low-speed wind tunnel for air flow simulation of hydrodynamic phenomena, and a wide range of structural testing equipment. Two small power boats are used for studies on nearby deep lakes.

The facility at Hampton, Virginia, includes a research laboratory, classroom and office space, with estuarine research carried out using an 18-foot electroshocking boat and six smaller craft.

The following degrees are offered:

1. B.S. in Aerospace and Ocean Engineering. Requirements: 204 quarter credits, including 30 credits of humanities and 18 credits of approved technical electives. Twenty-six degrees were awarded in 1978.

2. M.S. in Aerospace and Ocean Engineering. Requirements: 45 quarter credits, including nine-15 for thesis, or non-thesis option, and oral examination. Nine degrees were awarded in 1978.

3. Ph.D. in Aerospace Engineering with a specialty in Ocean Engineering. Requirements: 135 quarter credits including 45-85 for thesis. Three degrees were awarded in 1978.

4. B.S. in Forestry and Wildlife with Fisheries option. Requirements: 200 quarter credits including mathematics through one year of calculus and matrix algebra, statistics, computer science, 25 credits of physical science, 30 credits of biological science, 29 credits of fisheries and wildlife, and 39 credits of humanities and social sciences. Fifteen degrees were awarded in 1979.

5. M.S. in Fisheries and Wildlife Sciences. Requirements: 45 quarter credits including a maximum of 15 for thesis, a comprehensive examination, and defense of thesis. Meets educational requirements for certification by American Fisheries Society and as fisheries biologist with U.S. Civil Service Commission. Four degrees were awarded in 1979.

6. Ph.D. in Fisheries and Wildlife Sciences. Requirements: 135 quarter credits including a maximum of 85 for research and dissertation; qualifying exam, comprehensive preliminary exam, and dissertation defense. Four degrees were awarded in 1979.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

AOE	3101	Fundamentals of Aero/Hydrodynamics	3
AOE	3270	Vehicle Performance	3
AOE	3310	Ocean Engineering Models and Methods	3
AOE	3251	Structures I	3
AOE	3152	Ocean Engineering Laboratory	2
AOE	3252	Structures II	3
AOE	3210	Vehicle Vibration Analysis	3
AOE	3253	Structures III	3
AOE	3240	Vehicle Stability and Control	3
AOE	4240	Vehicle Stability and Control II	3
AOE	3140	Boundary Layer and Heat Transfer I	3
AOE	4140	Boundary Layer and Heat Transfer II	3
GEOL	4000	General Oceanography	3
AOE	4011	Design	2
AOE	4012	Design	3
AOE	4500	Ocean Acoustics	3
ME	4310	Naval Architecture	3
ME	4330	Marine Engineering	3
ME	4140	Underwater Vehicles	3
F1W	1001	Introduction to Forestry and Wildlife	3
F1W	1002	Introduction to Forestry and Wildlife	3
F1W	1003	Introduction to Forestry and Wildlife	3
F1W	3300	Introduction to Fisheries Science	3
F1W	3310	Fisheries Science Lab	1
F1W	3500	Principles of Wildlife Management	3
F1W	3510	General Systems Ecology	3
F1W	3601	Outdoor Recreation	3
F1W	4200	Fisheries Science	3
F1W	4210	Ichthyology	4
F1W	4300	Fisheries Management	4
F1W	4310	Aquaculture	3

GRADUATE COURSES

AOE	5101	Advanced Aero/Hydrodynamics	3
AOE	5141	Boundary Layer Theory and Heat Transfer	3
AOE	5142	Boundary Layer Theory and Heat Transfer	3
AOE	5970	Independent Study	Arranged
AOE	6100	Three-dimensional Aero/Hydrodynamics	3
AOE	6310	Dynamics of the Ocean	3
AOE	6320	Hydromechanics of Aquatic Animal Motion	3
AOE	6311	Theory of Stratified Flow	3
AOE	6312	Theory of Stratified Flow	3
AOE	5131	Vehicle Propulsion	3
AOE	5221	Vehicle Structures	3
AOE	5222	Vehicle Structures	3
AOE	5223	Vehicle Structures	3
AOE	5210	Dynamics of Aerospace and Ocean Vehicles	3
AOE	6241	Optimization Techniques	3
AOE	6242	Optimization Techniques	3
F1W	5200	Fisheries Biology	4
F1W	5300	Fisheries Theory	4
F1W	5350	Fisheries and Wildlife Planning	3
F1W	5400	Wildlife Population Dynamics	4
F1W	5601	Outdoor Recreation Theory	3
F1W	5602	Practices in Outdoor Recreation	3
F1W	5603	Research in Outdoor Recreation	3
F1W	5970	Independent Study	Arranged
F1W	5980	Advanced Fisheries Management	3
F1W		Fish Physiology and Nutrition	3
F1W		Marine Fisheries	3

The instructional staff for the courses listed above consists of the following:

AEROSPACE AND OCEAN ENGINEERING

Anderson, Leonard, Ph.D., Assistant Professor
Cliff, Eugene M., Ph.D., Associate Professor
Inger, George R., Ph.D., Professor
Jakubowski, Antoni K., Ph.D., Assistant Professor
Kelley, Henry, Ph.D., Professor
Lewis, Clark H., Ph.D., Professor
Lutze, Frederick H., Ph.D., Associate Professor
Magnuson, Allen, Ph.D., Associate Professor
Marchman, James F., Ph.D., Associate Professor
Rooney, David, Ph.D., Assistant Professor
Schetz, Joseph A., Ph.D., Professor and Department Head
Sundkvist, Carl, Ph.D., Assistant Professor

FISHERIES AND WILDLIFE

Cross, G.H., Ph.D., Associate Professor and Department Head
Garling, D.R., Ph.D., Assistant Professor
Giles, R.H., Jr., Ph.D., Professor
Helfrich, L.A., Ph.D., Assistant Professor
Neves, R.J., Ph.D., Assistant Leader, Virginia Cooperative Fisheries Research Unit
Ney, J.J., Ph.D., Assistant Professor
Nielsen, L.A., Ph.D., Assistant Professor
Pardue, G.B., Ph.D., Leader, Virginia Cooperative Fisheries Research Unit

OUTDOOR RECREATION

Buhyoff, G.J., Ph.D., Assistant Professor
Roggenbuck, J.W., Ph.D., Assistant Professor
Wellman, J.D., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Dr. Allen Magnuson
Department of Aerospace and Ocean Engineering

or,

Dr. Gerald H. Cross, Head
Department of Fisheries and Wildlife Sciences
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

WALLA WALLA COLLEGE
College Place, Washington 99324

The College offers marine science courses at its marine station on Puget Sound near Anacortes. Supporting coursework is offered on the main campus at

College Place. Facilities for the maintenance and use of marine organisms in research are available in the life science complex completed on the main campus in 1967. The Walla Walla College Marine Station provides two teaching and research laboratory buildings serviced by a circulating salt-water system. In addition, the marine station operates a research vessel, the 45-foot Seastar and has a 16-foot Boston Whaler. A number of smaller boats are available for research work associated with the courses being offered. Scuba equipment is available.

The degree of M.S. in Biology with an emphasis in marine biology is offered in the Department of Biology.

All students must complete a minimum of 45 graduate-approved credits, pass written and oral departmental examinations, and demonstrate ability to carry out independent research fulfilling the thesis requirement.

The degree of M.S. in Biology was awarded to six candidates during the 1978-1979 school year.

The following courses are offered in conjunction with the above program:

UNDERGRADUATE COURSES

428	Physiology of the Algae	4
429	Limnology	4
451	Invertebrate Zoology	5
462	Ichthyology	4
463	Marine Botany	4
464	Animal Behavior	4
467	Biological Oceanography	4
468	Comparative Physiology	4
470	Biophysics	4
474	Marine Invertebrates	4

GRADUATE COURSES

510	Graduate Seminar	1
511	Biosystematics	4
514	Symbiosis	4
525	Readings in Physiology	4
526	Readings in Invertebrate Zoology	4
528	Readings in Ecology	4
529	Readings in Symbiosis	4
530	Readings in Biosystematics	4
545	Thesis	8

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Amlaner, Charles, D. Phil., Assistant Professor
Barnes, Ross O., Ph.D., Research Associate Professor
Dickson, Leal G., Ph.D., Associate Professor
Galusha, Joseph G., D. Phil., Associate Professor and Chairman, Department of Biology
Grable, Albert E., Ph.D., Associate Professor
McCloskey, Lawrence R., Ph.D., Professor
Rigby, Donald W., Ph.D., Professor

PHYSICS

Barnett, Claude C., Ph.D., Professor

To obtain further information, address inquiries to:

Chairman, Department of Biology
Walla Walla College
College Place, Washington 99324

WASHINGTON TECHNICAL INSTITUTE
Washington, D.C. 20008

Washington Technical Institute has an Environmental Science Department which offers a program of technical training in Marine Science Technology.

The principal teaching facility is the main campus at 4100 Connecticut Avenue, N.W., Washington, D.C.

The field stations for research, laboratory, and ship training are located at Wallops Island, Virginia, and at Lewes, Delaware. Courses of study at these two field stations are offered throughout the summer by the Marine Science Consortium, of which Washington Technical Institute is a member. Equipment use and handling is taught aboard the R/V Annandale, a 90-foot vessel and aboard Boston Whalers and MBT's. Equipment includes salinometers, STD recorders, turbidimeters, Nansen bottles, Nisken samplers, corers and trawls. Scuba diving is offered during the summer at the main campus.

An Associate of Applied Science (AAS) degree is offered.

The following courses are offered in conjunction with the above program:

HC 101	General Chemistry I	4
HC 102	General Chemistry II	4
CT 105	Data Processing	3
NE 105	Science of Man's Environment	4
NM 107	Biological Oceanography	6
GM 111	Technical Mathematics I	3
GM 112	Technical Mathematics II	3
GM 113	Technical Mathematics III	3
EE 101	Basic Electricity I	4
NE 211	Environmental Microbiology I	4
NE 212	Environmental Microbiology II	4
NM 201	Physical Oceanography I	4
NM 202	Physical Oceanography II	4
NM 205	Data Handling and Analysis	4
NM 206	Geological Oceanography	4
NE 211	Environmental Statistics I	3
NE 212	Environmental Statistics II	3
GP 101	Physics I	4
GP 102	Physics II	4
GP 103	Physics III	4
NE 145	Marine Instrumentation	4
NM 108	Scuba	3

The instructional staff for the courses listed above consists of the following:

Berryman, Matilene S., J.D., Professor
Jones, A. Jose, Ph.D., Associate Professor
Kakovitch, Thomas, M.S., Assistant Professor
Watt, Mamadou, Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Chairman
Environmental Science Department
School of Agriculture and Natural Resources
Washington Technical Institute
4100 Connecticut Avenue, N.W.
Washington, D.C. 20008

WEBB INSTITUTE OF NAVAL ARCHITECTURE
Glen Cove, New York 11542

The College offers a course of study in naval architecture and marine engineering to train and educate young persons who are interested in the design and construction of ships.

Specialized facilities include a 93-foot long model basin with wave maker, a flow channel, a marine engineering laboratory which includes operating components of commonly encountered marine machinery and a time-sharing computer facility.

The Bachelor of Science in Naval Architecture and Marine Engineering is offered by the institute.

The following courses are required in conjunction with the above program:

Vibrations
Practical Naval Architecture I
Practical Naval Architecture II
Ship Resistance and Propellers I
Ship Resistance and Propellers II
Theoretical Naval Architecture I
Theoretical Naval Architecture II
Theoretical Naval Architecture III
Theory of Structures
Ship Design I
Ship Design II
Marine Engineering I
Marine Engineering II
Marine Engineering III
Marine Engineering IV
Marine Engineering V
Hydrodynamics
Fluid Mechanics

These are in addition to required courses in mathematics, science, basic engineering and the humanities, which together with the above total 148 credit hours required for the degree. All students are enrolled full time.

The instructional staff for the courses listed above consists of the following:

Bond, Thomas H., M.E.E., Professor of Electrical Engineering
Goldberg, Martin A., Ph.D., Professor of Engineering
Hadler, Jacques B., S.M., Research Professor of Naval Architecture
Hamlin, Norman A., S.M., Research Professor of Naval Architecture
Holm, Jens T., M.S., Professor of Marine Engineering
Nevitt, Cedric R., S.M., Professor of Naval Architecture
Rowen, Alan B., M.S., Associate Professor of Marine Engineering
Ward, Lawrence W., D.Sc., Professor of Engineering

To obtain further information, address inquiries to:

C.N. Payne, Rear Admiral, USN (ret.)
President
Webb Institute of Naval Architecture
Glen Cove, New York 11542

WESTERN CONNECTICUT STATE COLLEGE
Danbury, Connecticut 06810

Within a radius of 30 miles, Danbury is surrounded by lakes, ponds, and reservoirs in the western part of Connecticut. We can easly reach the following aquatic environments: Lake Candlewood (the third largest lake in New England) and Long Island Sound. A cooperative program exists between the Candlewood Lake Authority and the Western Connecticut State College Department of Earth, Space and Environmental Sciences. We use their boats doing research work, and provide scientific services for them. We also use the boat facility of Schooner Inc. for the Long Island Sound study.

The major research equipment includes atomic absorption, Nansen bottles, bathythermograph, salinometer and cable, current meter, automatic oxygen burette, light meter, Secchi disc, Van Dorn water bottle, water analyzers, portable/field ion analyzer, gas chromatograph, handcorer, x-ray diffractometer, thin section machine, grinder and polishers, rock and mineral collection, orange-peel sampler, oscilloscopes, teletypes, facsimile, radio (high frequency), Clarke-Bumpus plankton sampler, multiple plankton sampler.

M.A. in Oceanography and Limnology is offered by the Department of Earth, Space and Environmental Sciences. A total of 30 credits is required to complete the degree. Two options are offered, with thesis and without thesis. A comprehensive examination for the degree is necessary. There have been 30 students registered in this program since it began two years ago.

The following courses are offered for this program:

Required Courses

ES 512	General Oceanography	3
ES 513	General Limnology	3
ES 550	Seminar in Oceanography and Limnology	1-3

Elective Courses

BIO 513	Marine Biology	3
ES 505	Paleoecology	3
ES 507	Marine Ecology	3
ES 509	Coastal Oceanography	3
ES 510	Navigation and Piloting	3
ES 531	Micropaleontology	3
ES 533	Marine Geology	3
ES 534	Marine Meteorology	3
ES 535	Physical Oceanography and Limnology	3
ES 536	Survey of Geophysics	3
ES 537	Aqueous Geochemistry	3
ES 551	Field Research in Oceanography or Limnology	1-3
ES 599	Student Developed Study	1-6
ES 591	Thesis	6
ES 400	Structural Geology	4
ES 420	Geophysical Hydrodynamics	4

The instructional staff for the courses listed above consists of the following:

Caldwell, Katherine, M.S., Assistant Professor
Chen, Chin, Ph.D., Professor and Coordinator of the Program
Goldstein, Mel, Ph.D., Chairman of the Department
Groff, Donald, Ph.D., Professor

To obtain further information, address inquiries to:

Dr. Jack Rudner, Dean
Graduate Studies and Extension Services
Western Connecticut State College
Danbury, Connecticut 06810

WESTERN KENTUCKY UNIVERSITY
Bowling Green, Kentucky 42101

Western Kentucky University is a charter member of the Tech Aqua Consortium which operates the Tech Aqua Biological Station on Center Hill Reservoir near Cookeville, Tennessee. The Station offers five field biology courses in each of two five-week summer sessions including Local Flora, Freshwater Algae, Ecosystem Analysis, Freshwater Invertebrates, Ichthyology, and Limnology. The graduate program is in Aquatic Biology.

The degree offered is Master of Science.

The prerequisites for the Master of Science Program are:

1. Minimum undergraduate grade point average of 2.50 and a combined verbal-quantitative score on the Graduate Record Examination of at least 800.

2. Two courses each in physics and inorganic chemistry and one course in organic chemistry.

Assistantships are awarded on a competitive basis. Typically, stipends are also available during the summer. Eligibility for an assistantship requires a minimum undergraduate grade point average of 2.75.

To obtain further information, address inquiries to:

Dr. Herbert Shadowen
Professor of Biology
Western Kentucky University
Bowling Green, Kentucky 42101

WESTERN MICHIGAN UNIVERSITY
Kalamazoo, Michigan 49001

Western Michigan University offers opportunities for graduate students in either biology or geology to concentrate in aquatic sciences. This may be in the Great Lakes or in marine waters. Active teaching and research programs in both areas are in progress. Excellent laboratory facilities are available in both departments. Opportunities for summer field courses exist in addition to the usual on-campus studies. The University is a member of two consortiums, each of which has marine-oriented summer programs. These are Central States Universities, Inc., and Associated Universities for International Education. The latter operates out of St. John's College in Belize, British Honduras.

The following degrees are offered. Concentrations in marine-related aspects of either are possible.

1. M.A. in Biology. Requirements: 30 credit hours in biology and related areas and completion and defense of a thesis.

2. M.A. in Geology. Requirements: 30 credit hours (as many as nine hours may be outside the department), completion of a thesis, and defense of thesis.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Biol 301	Ecology	3
Geog 225	Introduction to Meteorology and Climatology	4
Geol 300	Oceanography	3

UNDERGRADUATE AND GRADUATE COURSES

Biol 528	Biology of Nonvascular Plants	3
Biol 541	Invertebrate Zoology	3
Biol 543	Protozoology	3
Biol 553	Limnology	3
Biol 555	Physiological Ecology	3
Biol 557	Tropical Marine Ecology	3
Biol 598	Reading in Biology	1-3
Biol 599	Independent Studies in Biology	1-4
Geol 502	Special Problems in Earth Science	1-3
Geol 533	Invertebrate Paleontology	4
Geol 535	Terrigeneous Depositional Systems	4
Geol 543	Paleoecology	-
Geol 544	Environmental Geology	3

GRADUATE COURSES

Biol 601	Special Investigations	2-6
Biol 602	Seminar (various areas)	2-6
Geol 620	Marine Geology	3
Geol 634	Research in Geology	1-4
Geol 610	Geochemistry	3
Geol 612	Hydrogeology	3
Geol 650	Sedimentary Petrology	3

To obtain further information, address inquiries to:

Lloyd J. Schmaltz
Professor and Chairman
Department of Geology
Western Michigan University
Kalamazoo, Michigan 49001

WESTERN WASHINGTON UNIVERSITY
Bellingham, Washington 98225

Western Washington University is administrator of the Leona M. Sundquist Marine Laboratory at Shannon Point located in Anacortes, Washington. The laboratory was established by the state of Washington to serve a variety of its publicly supported colleges and universities. Current members of the consortium served are: Eastern Washington University, Central Washington University, The Evergreen State College, Edmonds Community College, Everett Community College, Skagit Valley College, and Western Washington University. Other consortium members may be added in the future. Schools not in the consortium may use the facility on a space available basis. Sundquist Marine Laboratory is located on 73 forested acres which includes a five-acre freshwater lake and more than one-half mile of seawater frontage. The laboratory building has individual office-research spaces, 53 operating seawater tables, two student laboratories, a lecture room, a shop and storage area. Microscopes, sampling equipment of a great variety of sorts, testing gear, etc. are available. Boats consist of the following: a rubber Zodiac, a Boston Whaler, two navy whalers, an 18-1/2-foot Fiberform named, George, and a 34 foot by 12 foot diesel powered vessel called the Leona II.

Western Washington University offers an undergraduate major in marine biology and master's programs are available. The marine work at W.W.U. centers in the Department of Biology of the College of Arts and Sciences, and in Huxley College of Environmental Studies. The Sundquist Marine Laboratory is located administratively under the Office of Aquatic Studies, Director, Charles J. Flora.

The following courses are offered in conjunction with the B.S. degree program in Biology with a Marine Biology concentration (major concentration - 110 credits):

Biology 120	The Science of Biology	5
Biology 210	The Science of Biology	5
Biology 310	The Biology of Lower Organisms	5
Biology 312	Animal Biology	5
Biology 325	Ecology	5
Biology 340	Biometrics	5
Biology 403	Physiological Ecology of Animals	5
Biology 406	General Oceanography	5
Biology 407	Current Environment	3
Biology 456	Algae	5
Biology 490	Principles of Organic Evolution	4
Biology 460	Invertebrate Zoology	5
or		
Biology 461	Marine Invertebrate Zoology	5
Chemistry 121, 122, 123	General Chemistry I, II, III	5 ea.
Chemistry 251	Elementary Organic Chemistry	5
or		
Chemistry 351, 352, 353		4, 4, 3
Physics 131	Principles of Physics	4
Math 220	Introduction to Calculus	5
or		
Physics 121	College Algebra	5
Physics 122	Analytical Geometry and Calculus	5

ELECTIVES (under advisement -- to be choosen from the following list so as to total at least 22 credits)

Biology 321	Hereditary Biology	5
Biology 323	Cellular, Mollecular and Developmental Biology	5
Biology 361	Biology of Commercially Important Marine Species	5
Biology 362	Field Trips in Commercial Fisheries and Fishery Laboratories	2
Biology 460	Invertebrate Zoology	5
Biology 461	Marine Invertebrate Zoology	5
Biology 462	Ichthyology	5
Biology 468	Invertebrate Embryology	5
Biology 485	Historical and Philosophical Perspectives of Biology	5
Chemistry 333	Introductory Analytical Chemistry	5
Chemistry 471	Introductory Biochemistry	3
Chemistry 472	Introductory Biochemistry	3
Geology 211	Physical Geology	5
Geology 340	Geological Oceanography	3
Huxley 321	Oceanography and Marine Resources	3
Huxley 422	Pollution and Marine Ecology	5
Huxley 423	Techniques of Marine Analysis	4
Physics 132	Principles of Physics	5
Physics 133	Principles of Physics	5

The following courses in the marine sciences are offered by the Huxley College of Environmental Science:

Huxley 321a, b	Oceanography and Marine Resources and Lab	5

Huxley 330a, b	Applied Ecology and Lab	5
Huxley 442	Pollution and Marine Analysis	5
Huxley 423	Techniques of Marine Analysis	4
Huxley 311	Introduction to Environmental Planning	4
Huxley 350a, b	Introduction to Environmental Pollution and Lab	5
Huxley 361	Water Pollution	4
Huxley 436	Environmental Impact Statements	6
Huxley 331a, b	Applied Population Ecology and Lab	5
Huxley 365	Energy and Energy Resources	4
Huxley 435	Ecosystems Analysis and Modeling	4
Huxley 483	Resource Economics	4
Huxley 485	Resource Management	4

The Department of Geology in the College of Arts and Sciences at W.W.U. offers:

Geology 340	Geological Oceanography	3

The instructional staff associated with the marine programs at Western is as follows:

DEPARTMENT OF BIOLOGY

Broad, A. Carter, Ph.D., Professor
Dube, Maurice A., Ph.D., Associate Professor
Fonda, Richard W., Ph.D., Professor
Guthrie, Dan J., Ph.D., Assistant Professor
Harris, Martin J., Ph.D., Assistant Professor
Rhoades, Fred M., M.S., Lecturer
Ross, June R.P., Ph.D., Professor
Schneider, David E., Ph.D., Associate Professor
Taylor, Ronald J., Ph.D., Professor

HUXLEY COLLEGE

Cook, Susan, Ph.D., Assistant Professor
Smith, Gary C., Ph.D., Assistant Professor
Summers, William C., Ph.D., Associate Professor
Webber, Herbert H., Ph.D., Associate Professor

DEPARTMENT OF GEOLOGY

Schwartz, Maurice L., Ph.D., Professor

DEPARTMENT OF GEOGRAPHY

Terich, Thomas A., Ph.D., Assistant Professor

To obtain further information, address inquiries to:

Charles J. Flora, Director
Aquatic Studies Program
Western Washington University
Bellingham, Washington 98225

WEST VIRGINIA UNIVERSITY
Morgantown, West Virginia 26506

The West Virginia University program in Marine Science is part of the Marine Science Consortium, Inc. The various courses in Marine Science are only offered in the summer term. Laboratory facilities include the Delaware Bay Marine Science Center at Lewes, Delaware, the Wallops Island Marine Science Center at Wallops Island, Virginia and the Lake Erie Marine Science Center at Erie, Pennsylvania. Research vessels include the 90-foot R/V Annandale, the 50-foot R/V Delaware Bay, the 40-foot R/V Chincoteague Bay, the 38-foot R/V Everett and the 34-foot R/V Cat. Classrooms, wet and dry laboratories, workshops, garages, dormatories, etc. are part of each center's facilities. In addition, all standard oceanographic equipment is available.

The B.S., M.S., and Ph.D. degrees in Biology, Geology, and Wildlife Biology are offered with an emphasis in marine sciences. However, degrees are not offered in the specific areas of oceanography or marine biology.

The following courses are offered:

UNDERGRADUATE COURSES

Mar. Sci. 110	Introduction to Oceanography	3
Mar. Sci. 211	Field Methods in Oceanography	3
Mar. Sci. 212	Navigation	3
Mar. Sci. 221	Marine Invertebrates	3
Mar. Sci. 241	Marine Biology	3
Mar. Sci. 250	Management of Wetland Wildlife	3
Mar. Sci. 283	Aquatic Ecology	3
Mar. Sci. 320	Marine Microbiology	3
Mar. Sci. 331	Chemical Oceanography	3
Mar. Sci. 342	Marine Botany	3
Mar. Sci. 343	Marine Ichthyology	3
Mar. Sci. 362	Marine Geology	3
Mar. Sci. 398	Development of Marine Organisms	3
Mar. Sci. 498	Topics in Marine Science	3

GRADUATE COURSES

Mar. Sci. 500	Problems in Marine Science	3
Mar. Sci. 530	Coastal Sedimentation	3
Mar. Sci. 570	Research Cruise	3
Mar. Sci. 581	Great Lakes Plankton	3
Mar. Sci. 598	Topics in Marine Science	3

The instructional staff from West Virginia University consists of the following:

BIOLOGY

DeCosta, John, Ph.D., Associate Professor
Marshall, Joseph, Ph.D., Associate Professor

GEOLOGY

Donaldson, Alan, Ph.D., Professor
Renton, John, Ph.D., Associate Professor

WILDLIFE BIOLOGY

Michael, Edwin, Ph.D., Professor
Smith, Robert, Ph.D., Professor

To obtain further information, address inquiries to:

Dr. Joseph A. Marshall
Department of Biology
West Virginia University
Morgantown, West Virginia 26506
(304) 293-5201

WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts 02543

Research at the Institution encompasses the range of basic sciences as they apply to the marine environment: biology, physics, chemistry, geology, and geophysics, as well as ocean engineering and marine policy. Some 200 scientists and technicians and a support staff of about 700 are housed in four large laboratories and a variety of smaller facilities located in the village of Woods Hole and on the nearby Quissett Campus. Another 75 people operate three research vessels ranging from 177 to 245 feet in length, the deep-diving submersible Alvin and mothership, and a small coastal vessel. Computer services are provided within the Institution and with necessary links to other institutions, and the library facilities are shared with the Marine Biological Laboratory and supplemented by collections of the Northeast Fisheries Center of the National Marine Fisheries Service and the Branch of Atlantic-Gulf of Mexico Geology of the U.S. Geological Survey, all located in Woods Hole. The village is located on the southwest corner of Cape Cod about 80 miles south of Boston.

The Woods Hole Oceanographic Institution, in concert with the Massachusetts Institute of Technology, and with cooperation from several other universities, offers graduate degree programs in oceanography and oceanographic engineering. The M.I.T./W.H.O.I. Joint Program is the principle pathway for the majority of students entering graduate studies at Woods Hole.

Students admitted to the Joint Program in Oceanography/Oceanographic Engineering have access to the facilities and the staff, as well as the extensive physical facilities of both institutions. All decisions from admission to the conferring of the degree -- a single document issued by both institutions -- are made by concensus of joint M.I.T./W.H.O.I. committees. All students applying to the Woods Hole Oceanographic Institution for graduate degree programs are first considered for admission to the Joint Program. For qualified students whose interests are not best served by the Joint Program, programs of advanced study and research may be offered by the Woods Hole Oceanographic Institution which lead to the Ph.D. in Oceanography, awarded by W.H.O.I. alone. Cross-registration arrangements with Harvard University and Brown University, and other less formal cooperative agreements with the Biology and Geology and Geophysics Departments at Yale University and other schools, provide opportunities to develop special academic study programs tailored to the individual needs of the student.

The following degrees are offered in Oceanography:

1. Ph.D. and Sc.D. in Oceanography, offered jointly by W.H.O.I. and M.I.T.

2. Ph.D. in Oceanography offered by the Woods Hole Oceanographic Institution.

Students in either doctoral degree program may concentrate in one or more of the following areas: biological oceanography, chemical oceanography, marine geology, marine geophysics or physical oceanography.

The usual steps to a degree are: enter the program the summer preceding the first academic year and work as a research assistant in Woods Hole; follow an individually designed program of advanced study and research in preparation for a general examination to be taken before the third year (the general examination tests for a comprehensive knowledge of oceanography and ability to identify and explore research problems); and submit a dissertation on significant original theoretical or experimental research and conduct a oral defense of the thesis.

Each student formulates, with the assistance of academic advisors (at least one from each institution), a program of studies involving courses, seminars, and research activities. There are no formal course requirements, but each degree candidate is expected to gain some degree of familiarity with the principal areas of oceanography, in addition to demonstrating a thorough knowledge of at least one major field of specialization. Place of residence is determined by the student's outlined program of study and research.

Courses available to students in the above programs include the many courses offered by the Massachusetts Institute of Technology, and most specifically those offered by the Departments of Biology, Earth and Planetary Sciences, and Meteorology. In addition the following course offerings are supplemented by numerous seminars and directed studies based on the individual needs of the students. Most courses are generally offered on an alternate year schedule and are numbered and given credit hours in accordance with the M.I.T. system.

GRADUATE COURSES IN OCEANOGRAPHY

--	Introduction to Biological Oceanography	9
7.43	Phytoplankton and Nutrient Cycling	9
7.44	Ecology of Oceanic Zooplankton	9
7.45	Benthos and Fish	9
7.46	Topics in Physiology and Biochemistry of Marine Animals	9
7.414	Sensory Mechanisms of Electric and Magnetic Reception	12
7.419	Topics in Biological Oceanography	6
12.72	Oceanic Petrology	9
12.73	Introduction to Marine Geology	12
12.74	Marine Micropaleontology	9
12.75	Marine Sediments	12
12.77	Marine Geophysical Data Interpretation	11
12.752	Paleomagnetism	9
12.774	Plants, Animals and Sediments	12
12.7[illegible]	Marine Sediments Laboratory	6
12.771	Student Seminar in Marine Geology/ Geophysics	6
12.773	Advanced Statistical Methods and Data Analysis	9
12.80	Marine Chemistry	14
12.84	Organic Geochemistry	9

12.779	Seminar in Marine Chemistry	8
19.841	Waves	9
19.842	Mesoscale Ocean Dynamics	12
19.851	Dynamics of Shallow Seas	9
19.853	Turbulence and Friction in the Ocean	8
19.80	Surface and Internal Gravity Waves	9
19.86	The General Circulation of the Oceans	9
19.87	Physical Properties of Sea Water	9

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGY

Backus, Richard H., Biologist and Senior Scientist
Capuzzo, Judith M., Zoologist and Assistant Scientist
Carey, Francis G., Physiologist and Associate Scientist
Goldman, Joel C., Biologist and Associate Scientist
Grassle, J. Frederick, Biologist and Associate Scientist
Grice, George D., Zoologist, Senior Scientist and Chairman
Guillard, Robert R.L., Botanist and Senior Scientist
Harbison, G. Richard, Biologist and Associate Scientist
Hulburt, Edward M., Biologist and Associate Scientist
Jannasch, Holger W., Microbiologist and Senior Scientist
Kalmijn, Adrianus J., Biophysicist and Associate Scientist
Kanwisher, John W., Biophysicist and Senior Scientist
Madin, Laurence P., Zoologist and Assistant Scientist
Mann, Roger L., Biologist and Assistant Scientist
Marcus, Nancy H., Biologist and Assistant Scientist
Murphy, Lynda S., Biologist and Assistant Scientist
Naiman, Robert J., Biologist and Associate Scientist
Ryther, John H., Marine Ecologist and Senior Scientist
Sanders, Howard L., Biologist and Senior Scientist
Scheltema, Rudolf S., Biologist and Associate Scientist
Stegeman, John J., Biologist and Associate Scientist
Taylor, Craig D., Microbiologist and Associate Scientist
Teal, John M., Biologist and Senior Scientist
Vaccaro, Ralph F., Biologist and Senior Scientist
Waterbury, John B., Microbiologist and Assistant Scientist
Watson, Stanley W., Microbiologist and Senior Scientist
Wiebe, Peter H., Zooplankton Biologist and Associate Scientist

DEPARTMENT OF CHEMISTRY

Bacon, Michael P., Chemical Oceanographer and Assistant Scientist
Bowen, Vaughan, Geochemist and Senior Scientist
Brewer, Peter G., Geochemist and Senior Scientist
Deuser, Werner G., Geochemist and Associate Scientist
Farrington, John W., Organic Geochemist and Associate Scientist
Gagosian, Robert B., Organic Chemist and Associate Scientist
Hunt, John M., Organic Chemist and Senior Scientist
Jenkins, William J., Physicist and Associate Scientist
Lee, Cynthia L., Organic Geochemist and Assistant Scientist
Mantoura, Richard F.C., Chemical Oceanographer and Assistant Scientist
Mottl, Michael J., Geochemist and Assistant Scientist
Nozaki, Yoshiyuki, Geochemist and Assistant Scientist
Sayles, Frederick L., Geochemist and Associate Scientist
Thompson, Geoffrey, Geochemist, Senior Scientist and Chairman
Wakeham, Stuart G., Analytical Chemist and Assistant Scientist
Zafiriou, Oliver C., Chemist and Associate Scientist

DEPARTMENT OF PHYSICAL OCEANOGRAPHY

Armi, Laurence D., Physical Oceanographer and Assistant Scientist
Beardsley, Robert C., Physical Oceanographer and Associate Scientist
Briscoe, Melbourne G., Physical Oceanographer and Associate Scientist
Bryden, Harry L., Physical Oceanographer and Assistant Scientist
Bunker, Andrew W., Meteorologist and Associate Scientist
Csanady, Gabriel T., Physical Oceanographer and Senior Scientist
Fofonoff, Nicholas P., Oceanographer and Senior Scientist
Georgi, Daniel T., Physical Oceanographer and Assistant Scientist
Haidvogel, Dale B., Physical Oceanographer and Assistant Scientist
Hogg, Nelson G., Physical Oceanographer and Associate Scientist
Joyce, Terrence M., Physical Oceanographer and Associate Scientist
Luyten, James R., Physical Oceanographer and Associate Scientist
McCartney, Michael S., Physical Oceanographer and Assistant Scientist
McComas, C. Henry, III, Physical Oceanographer and Assistant Scientist
Miller, Arthur R., Physical Oceanographer and Associate Scientist
Owens, W. Brechner, Physical Oceanographer and Associate Scientist
Pedlosky, Joseph, Physical Oceanographer and Senior Scientist
Rhines, Peter B., Theoretical Oceanographer and Senior Scientist
Richardson, Philip L., Physical Oceanographer and Associate Scientist
Schmitz, William J., Jr., Physical Oceanographer and Associate Scientist
Stommel, Henry M., Physical Oceanographer and Senior Scientist
Warren, Bruce A., Physical Oceanographer and Senior Scientist
Whitehead, John A., Jr., Physicist and Associate Scientist
Worthington, L. Valentine, Physical Oceanographer, Senior Scientist and Chairman

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

Aubrey, David G., Geological Oceanographer and Assistant Scientist
Beckerle, John C., Physicist and Associate Scientist
Berggren, William A., Micropaleontologist and Senior Scientist
Bowin, Carol O., Geologist and Senior Scientist
Bryan, Wilfred B., Petrologist and Associate Scientist
Denham, Charles R., Geophysicist and Associate Scientist
Dick, Henry J.B., Geologist and Assistant Scientist
Ewing, John I., Geophysicist, Senior Scientist and Chairman
Haq, Bilal U., Micropaleontologist and Associate Scientist
Heirtzler, James R., Geophysicist and Senior Scientist
Hollister, Charles D., Marine Geologist and Associate Scientist
Honjo, Susumu, Marine Geologist and Associate Scientist
Johnson, David A., Sedimentologist, Micropaleontologist and Associate Scientist
Lohmann, George P., Micropaleontologist and Associate Scientist
Milliman, John D., Marine Geologist and Associate Scientist
Purdy, G. Michael, Marine Geophysicist and Assistant Scientist
Ross, David A., Geological Oceanographer and Associate Scientist
Schouten, Hans A., Geophysicist and Associate Scientist
Stephen, Ralph A., Geophysicist and Assistant Scientist
Tucholke, Brian E., Marine Geologist and Associate Scientist
Uchupi, Elazar, Geologist and Associate Scientist
von Herzen, Richard P., Geophysicist and Senior Scientist

OCEANOGRAPHIC ENGINEERING

Joint degree programs are offered by the Woods Hole Oceanographic Institution and the Massachusetts Institute of Technology for students interested in applying a basic engineering knowledge to understanding and solving problems related to oceanography. The program is conducted jointly by the two institutions through the Department of Ocean Engineering at W.H.O.I. and through any one of the following engineering departments at M.I.T.: Chemical Engineering, Civil Engineering, Electrical Engineering and Computer Sciences, Materials Science and Engineering, Mechanical Engineering, or Ocean Engineering.

The following degrees are offered:

1. Engineer's degree in Oceanographic Engineering (degree designates basic engineering discipline, e.g., "Electrical Engineer"), offered jointly by W.H.O.I. and M.I.T.;

2. Ph.D. and Sc.D. in Oceanographic Engineering offered jointly by W.H.O.I. and M.I.T.

Specific degree requirements vary slightly depending on the student's department affiliation at M.I.T. In general, however, all students for the Engineer's degree will be expected to:

1. Meet all formal requirements of the pertinent M.I.T. department, which normally means a minimum of three academic terms of residence at M.I.T., primarily enrolled in required engineering courses;

2. Be in residence at W.H.O.I. for the first two summers (includes entering program in June instead of September) participating in on-going research activities;

3. Gain exposure to oceanography and oceanographic engineering by taking ocean-related courses (at least two) and working as a research assistant on oceanographic projects;

4. Preparing a thesis on an oceanographic engineering topic that meets the approval of co-advisors from M.I.T. and W.H.O.I.;

5. Complete the program in three years.

Doctoral degree candidates normally follow the same pattern of course requirements and residency as the Engineer's degree candidates during their first two years. By the end of their second year, doctoral candidates will have had to pass a two-part examination and presented an acceptable plan for a dissertation. At this time a student will take up residence at the institution most convient for carrying out the dissertation research. Doctoral degree candidates are expected, under normal circumstances, to complete the program in four years.

In addition to the many courses offered at the Massachusetts Institute of Technology, students in these programs are expected to take several of the following oceanographic engineering courses offered by W.H.O.I. staff, as well as some of the oceanography courses listed under the oceanography degree programs.

GRADUATE COURSES IN OCEANOGRAPHIC ENGINEERING

13.86	Ocean and Seabed Acoustics	12
13.990-.991	Oceanographic Systems I and II	12
13.992	Marine Navigation, Positioning, and Telemetry	12
13.994	Buoy Engineering	9
13.997	Principles of Oceanographic Instrument Systems I - Measurement Platforms	9
13.998	Principles of Oceanographic Instrument Systems II - Sensors and Measurements	12

DEPARTMENT OF OCEAN ENGINEERING

Ballard, Robert D., Geologist and Associate Scientist
Berteaux, Henri O., Engineering Physicist and Research Specialist
Frisk, George V., Phsicist and Assistant Scientist
Grant, William D., Coastal Engineering and Assistant Scientist
Hays, Earl E., Physicist, Senior Scientist and Chairman
Mavor, James W., Jr., Mechanical Engineer and Research Specialist
Orr, Marshall H., Physicist and Associate Scientist

Rosenfeld, Melvin A., Geologist and Senior Scientist
Smith, Woollcott K., Research Statistician and Research Specialist
Spindel, Robert C., Electrical Engineer and Associate Scientist
Walden, Robert G., Electronics Engineer and Research Specialist
Webb, Douglas C., Electrical Engineer and Senior Research Specialist
Weinstein, Ehud, Systems Engineer and Assistant Scientist
Williams, Albert J., III, Physicist and Associate Scientist

To obtain further information, address inquiries to:

A. Lawrence Peirson, III
Assistant Dean for Graduate Studies
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

Please see listing under Massachusetts Institute of Technology (page 80) for additional information on the M.I.T./W.H.O.I. Joint Program.

YALE UNIVERSITY
New Haven, Connecticut 06520

Instruction in the marine sciences is offered principally in the Departments of Geology and Geophysics and Biology. There is also a joint program in marine biology with Woods Hole Oceanographic Institution, in which students may take courses or do research at either institution. An interdepartmental program in geophysics is offered by the Departments of Geology and Geophysics and Engineering and Applied Science.

The following degrees are offered:

1. B.S. or B.A., generally after four years of undergraduate study.

2. Ph.D., generally after four years of study and research beyond the bachelor's level.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Bio	36a	Ecology
Bio	36b	Evolutionary Biology
Bio	37b	Biological Resources of the Sea
Bio	41a	The Invertebrates
Bio	48b	Tropical Marine Ecology
G&G	12a	Oceans
GUG	17b	Long Island Sound: Science and Use
G&G	32a	Chemistry of Natural Waters
G&G	35a	Introduction to Physical Oceanography
G&G	42b	Marine Paleoecology and Environmental Reconstruction

GRADUATE COURSES

Bio 336a	Ecology
Bio 341b	Comparative Morphology and Phylogency of the Invertebrates
Bio 348b	Tropical Marine Biology
Bio 383a, b	Seminar in Paleobiology of the Mollusca
Bio 384a	Paleobiology of Fishes
G&G 211b	Marine Paleoecology and Environmental Reconstruction
G&G 120a	Physics of the Earth's Surface
G&G 233a	Geophysical Fluid Dynamics
G&G 234a	Advanced Physical Oceanography
G&G 337b	Oceanographic Measurements and Observations
G&G 243b	Physical Chemistry of Sedimentary Processes
G&G 240b	Marine and Surficial Geochemistry

The instructional staff for the courses listed above includes the following:

BIOLOGY

Hartman, W.D., Ph.D., Associate Professor
Merriman, D., Ph.D., Associate Professor
Ramus, J.S., Ph.D., Assistant Professor
Thomson, K.S., Ph.D., Associate Professor
Trench, R., Ph.D., Assistant Professor
Waterman, T.H., Ph.D., Professor

GEOLOGY AND GEOPHYSICS

Berner, R.A., Ph.D., Professor
Gordon, R.B., D.Eng., Professor
Rhoads, D.C., Ph.S., Associate Professor
Rossby, H.T., Ph.D., Assistant Professor
Turekian, K.K., Ph.D., Professor
Veronis, G., Ph.D., Professor

To obtain further information, address inquiries to the Director of Graduate Studies in the department of interest.